TECHNOLOGY DEPT.

Gas Journal

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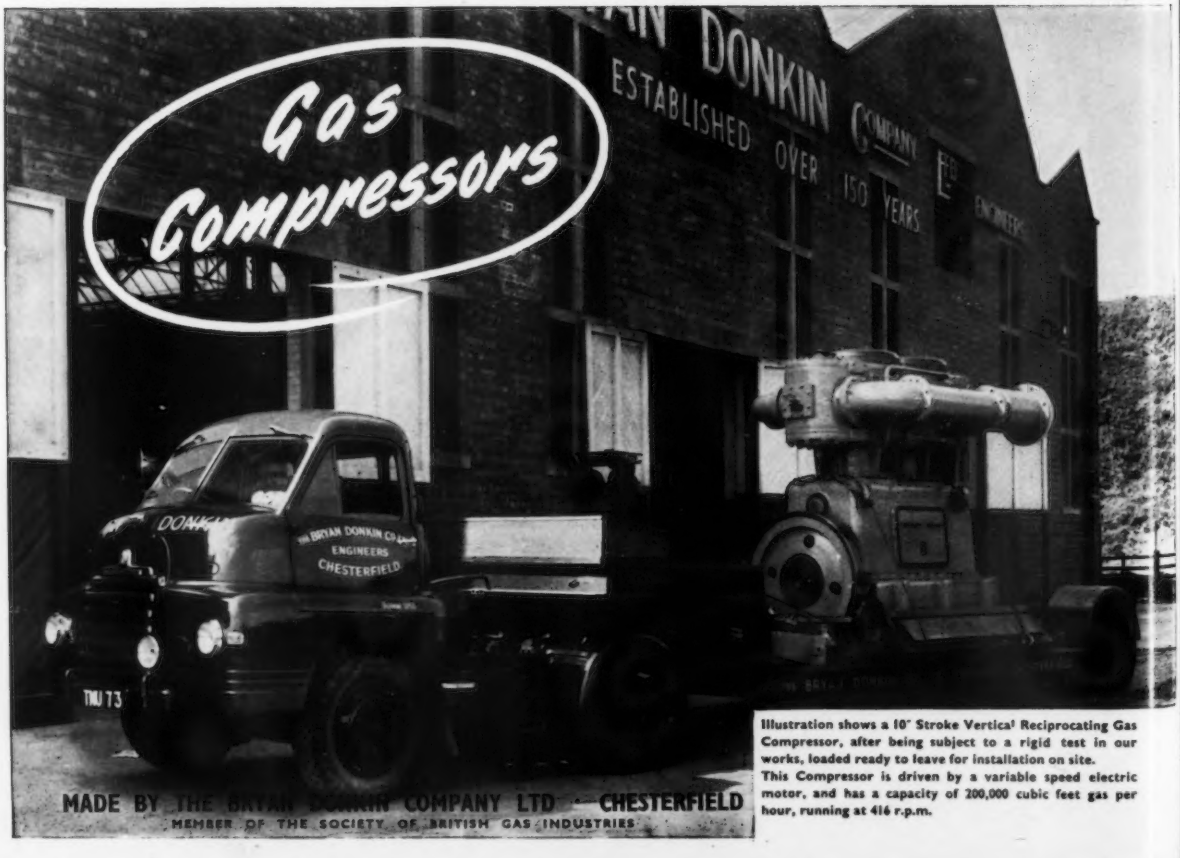

Illustration shows a 10" Stroke Vertical Reciprocating Gas Compressor, after being subject to a rigid test in our works, loaded ready to leave for installation on site. This Compressor is driven by a variable speed electric motor, and has a capacity of 200,000 cubic feet gas per hour, running at 416 r.p.m.

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$\frac{CO_2}{NH_3}$ ratio
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Contact Time
Temperature
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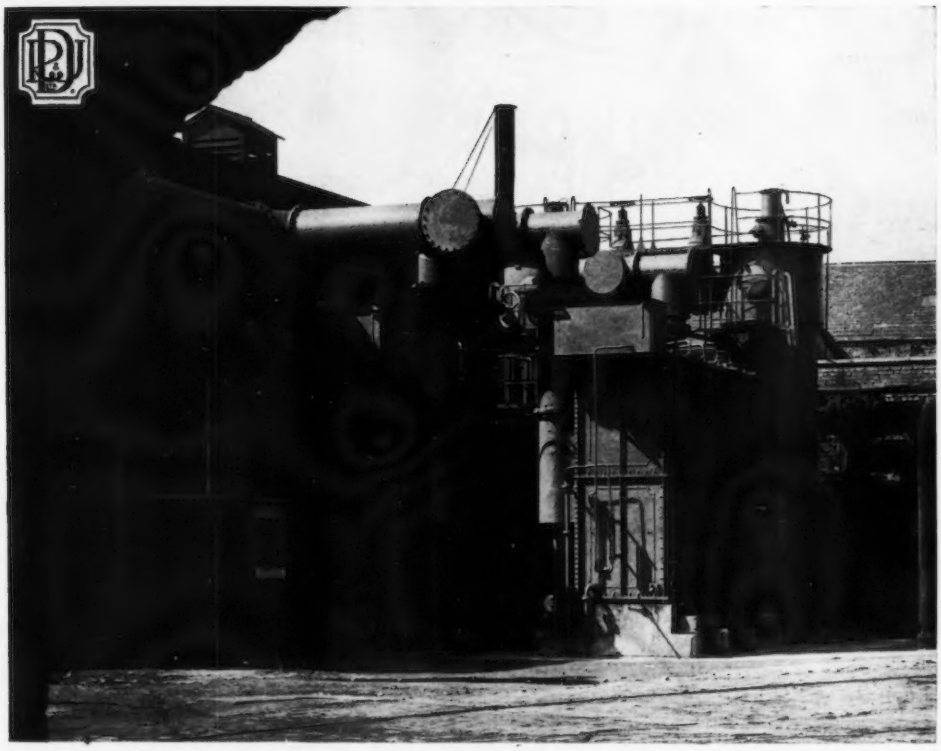

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(Photograph by courtesy of the North-Eastern Gas Board)

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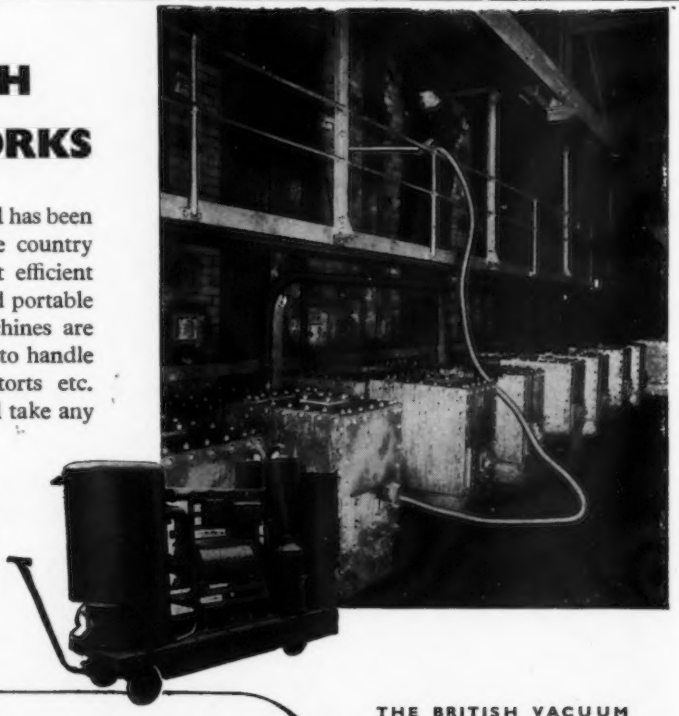

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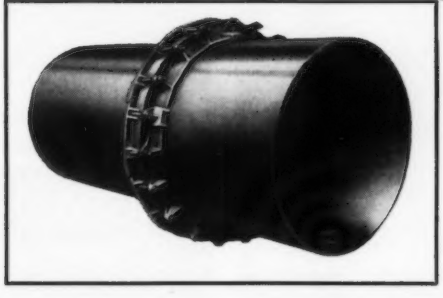

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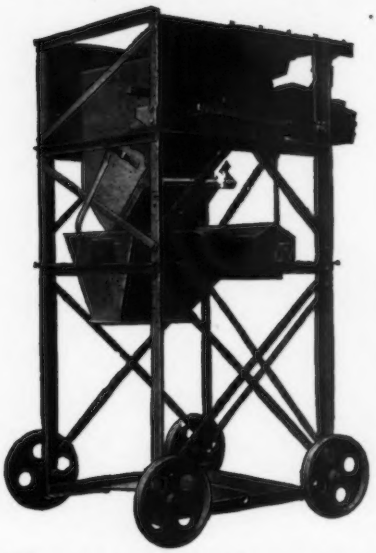

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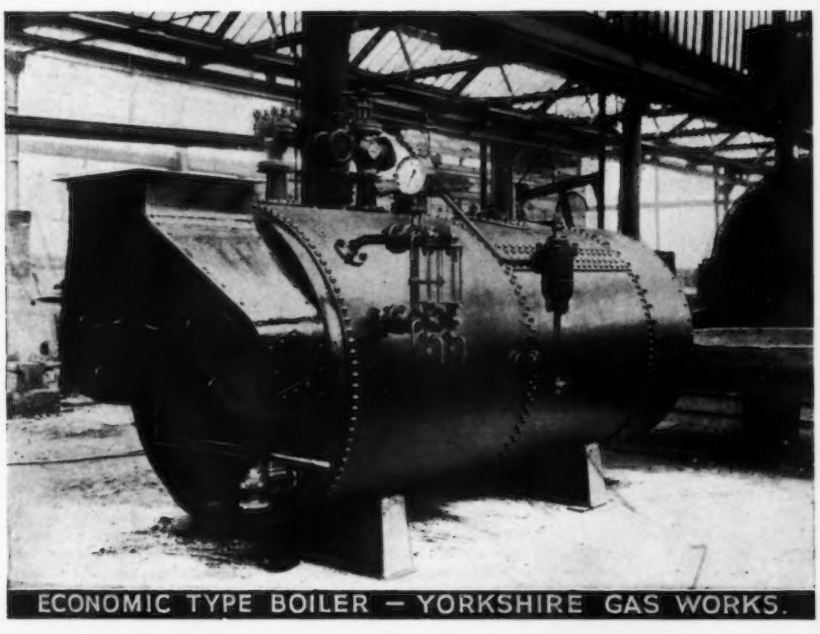

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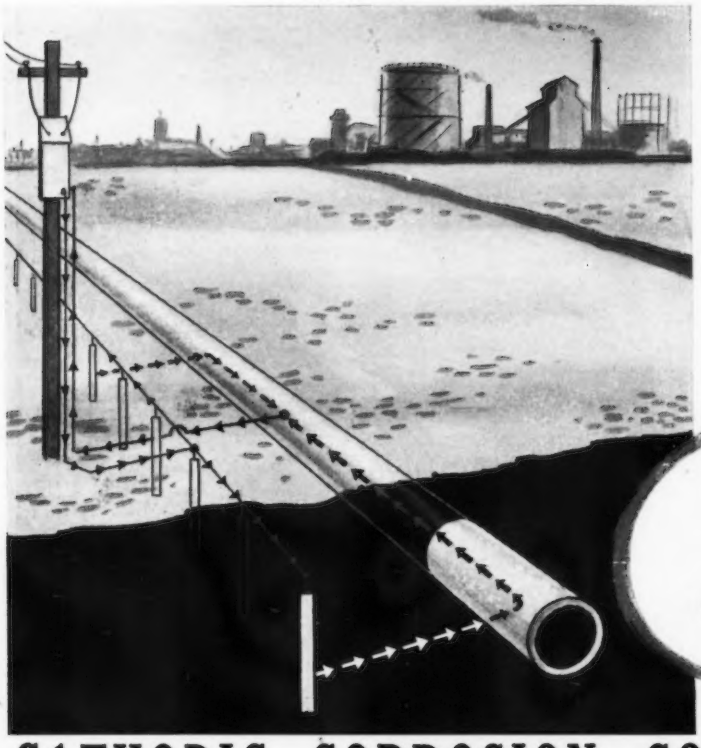

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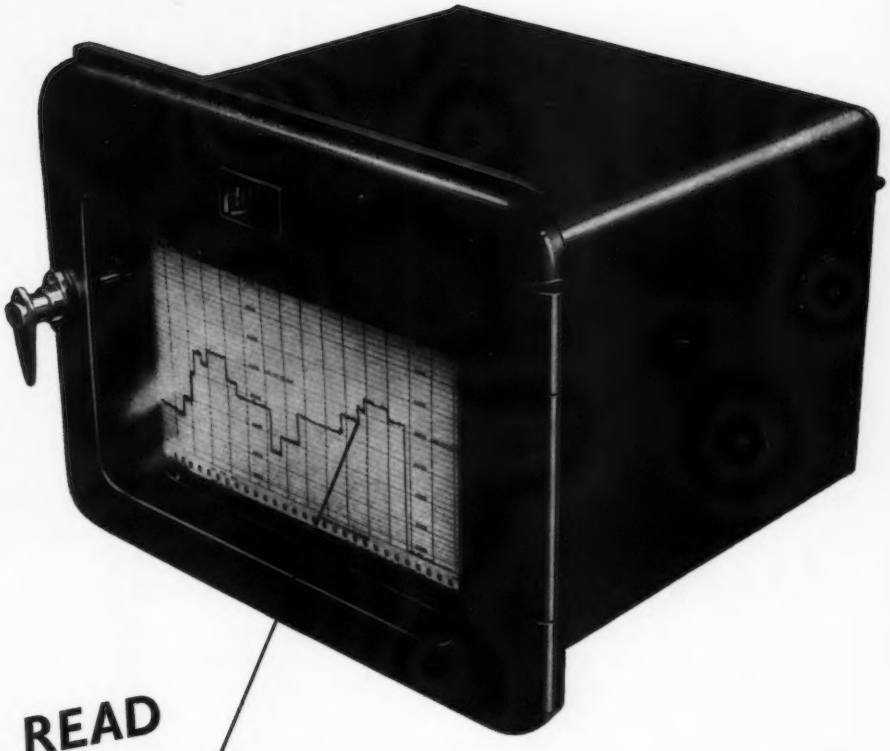

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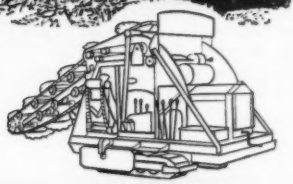

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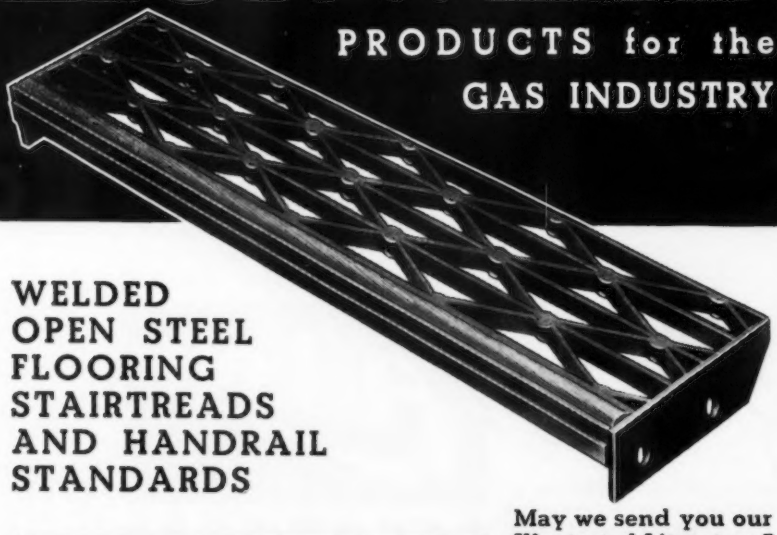

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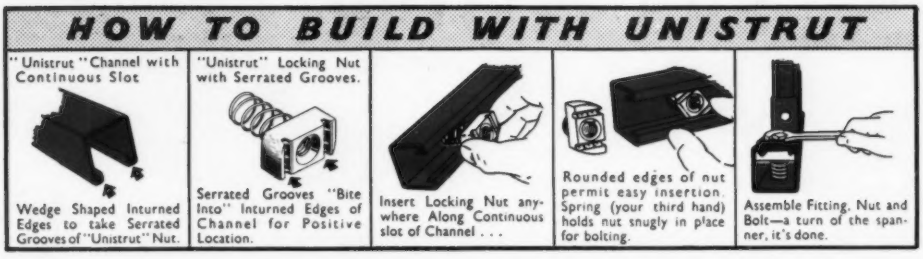
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Wedge Shaped Inturned Edges to take Serrated Grooves of "Unistrut" Nut.
"Unistrut" Locking Nut with Serrated Grooves.
Serrated Grooves "Bite Into" Inturned Edges of Channel for Positive Location.
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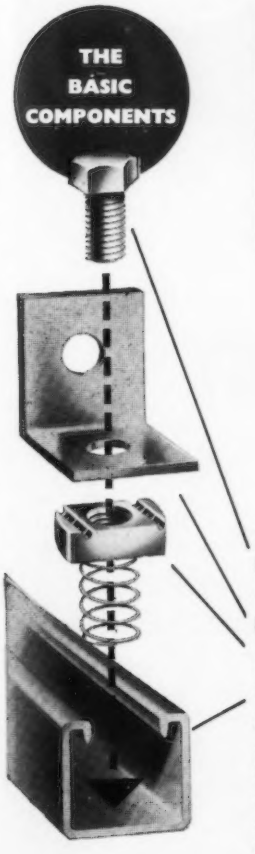

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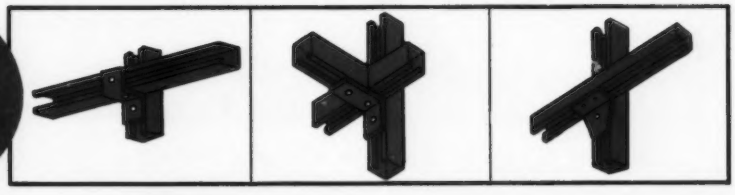
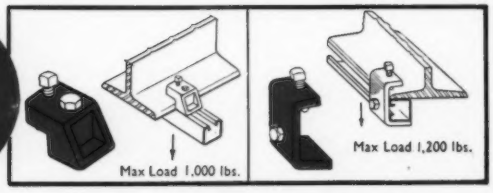
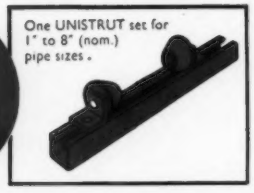


BEAM CLAMPS



ROLLER PIPE SUPPORTS



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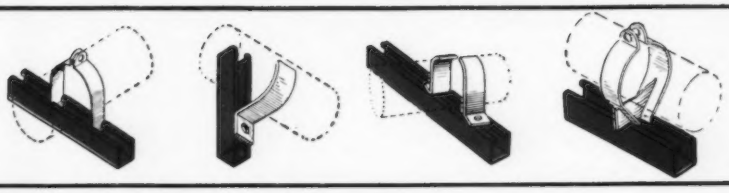
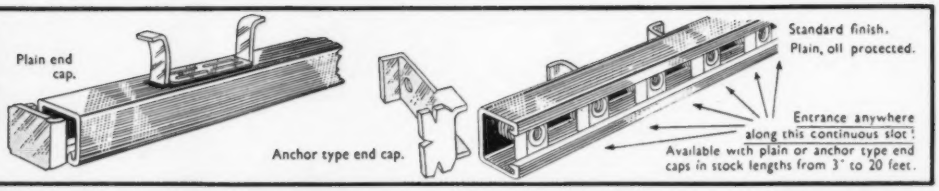


CONCRETE INSERTS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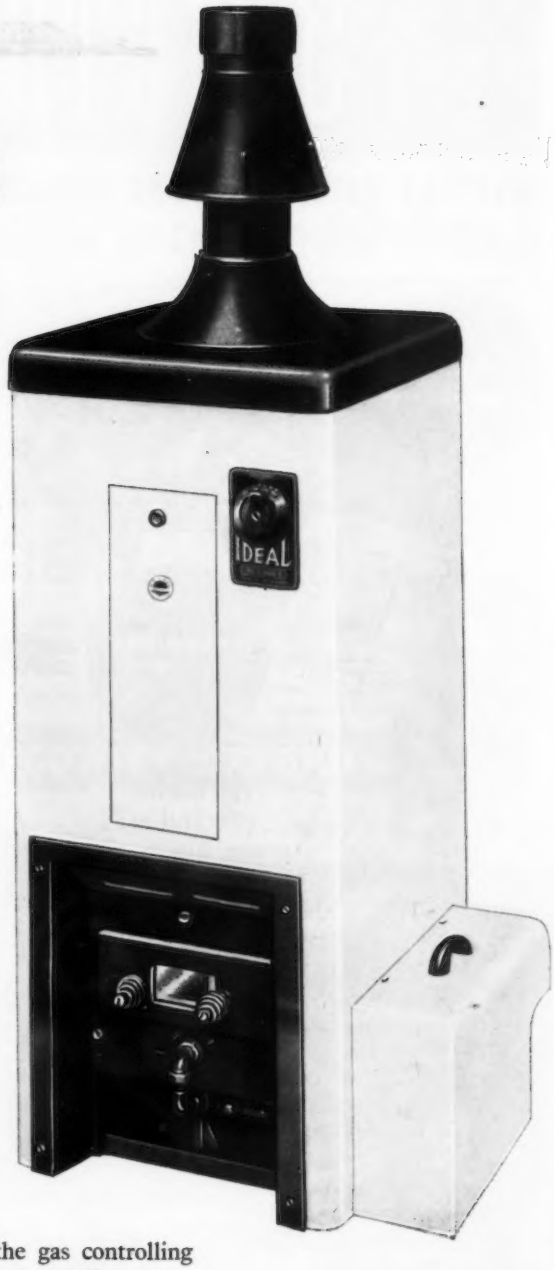

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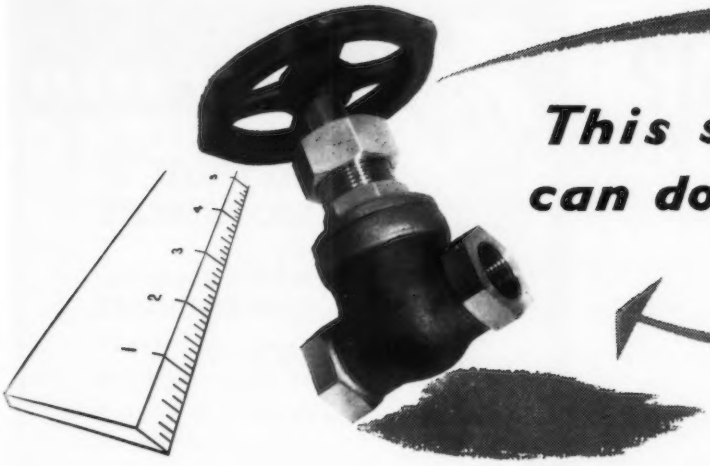

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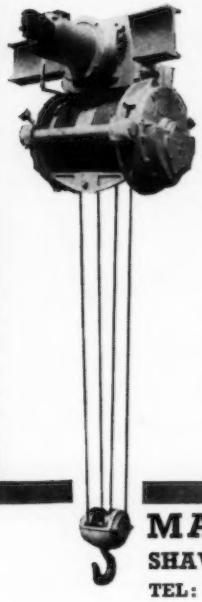

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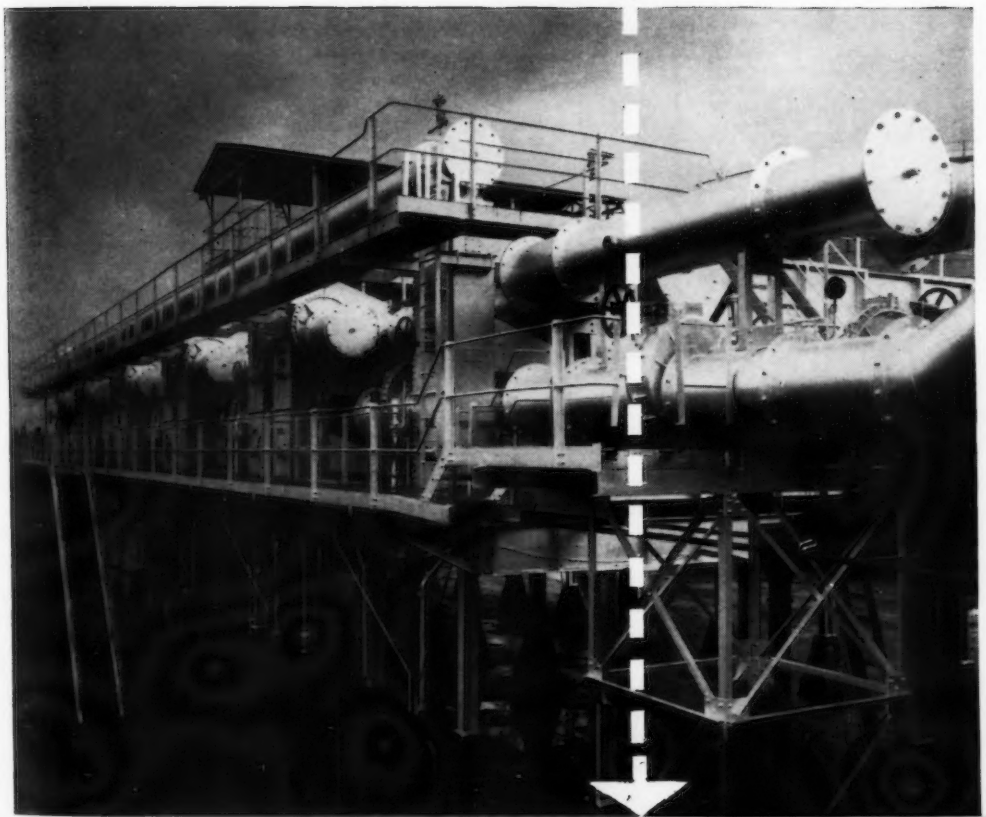

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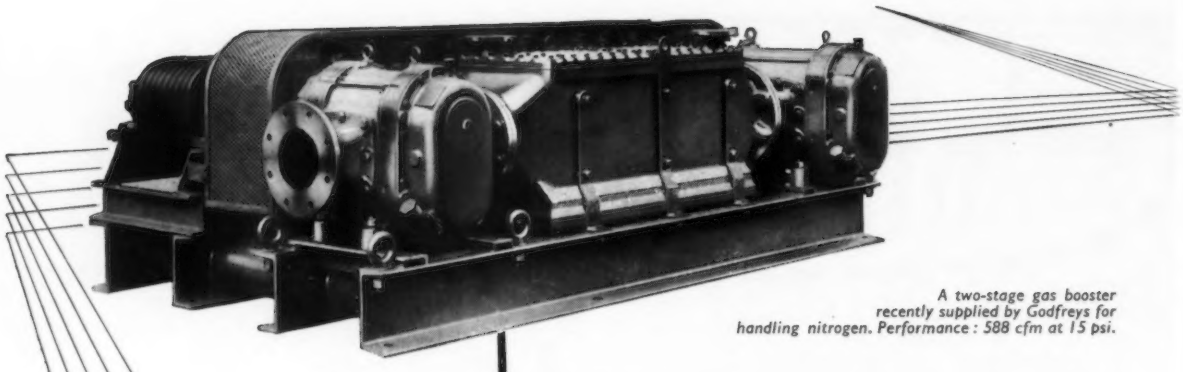

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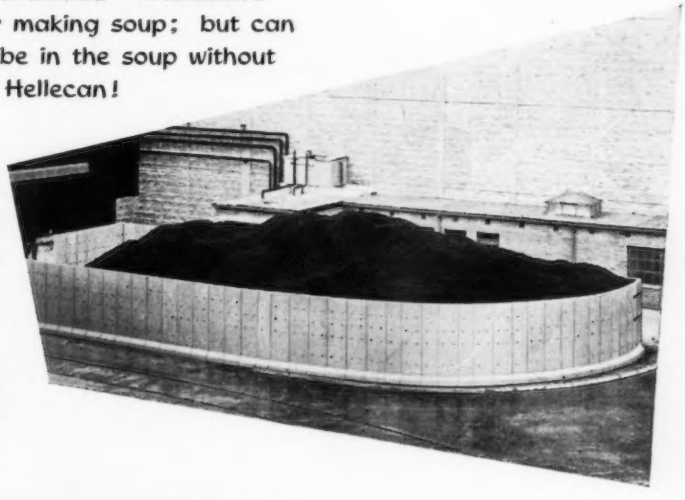

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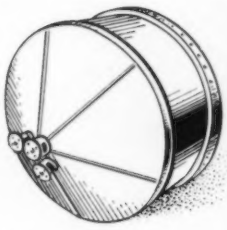

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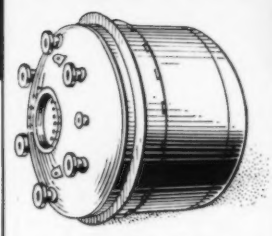

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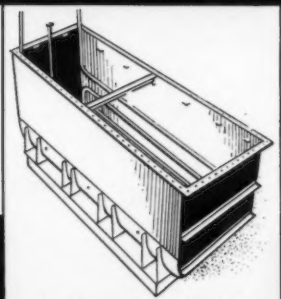

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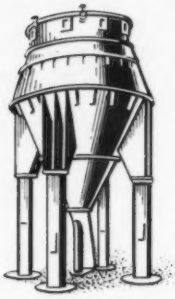

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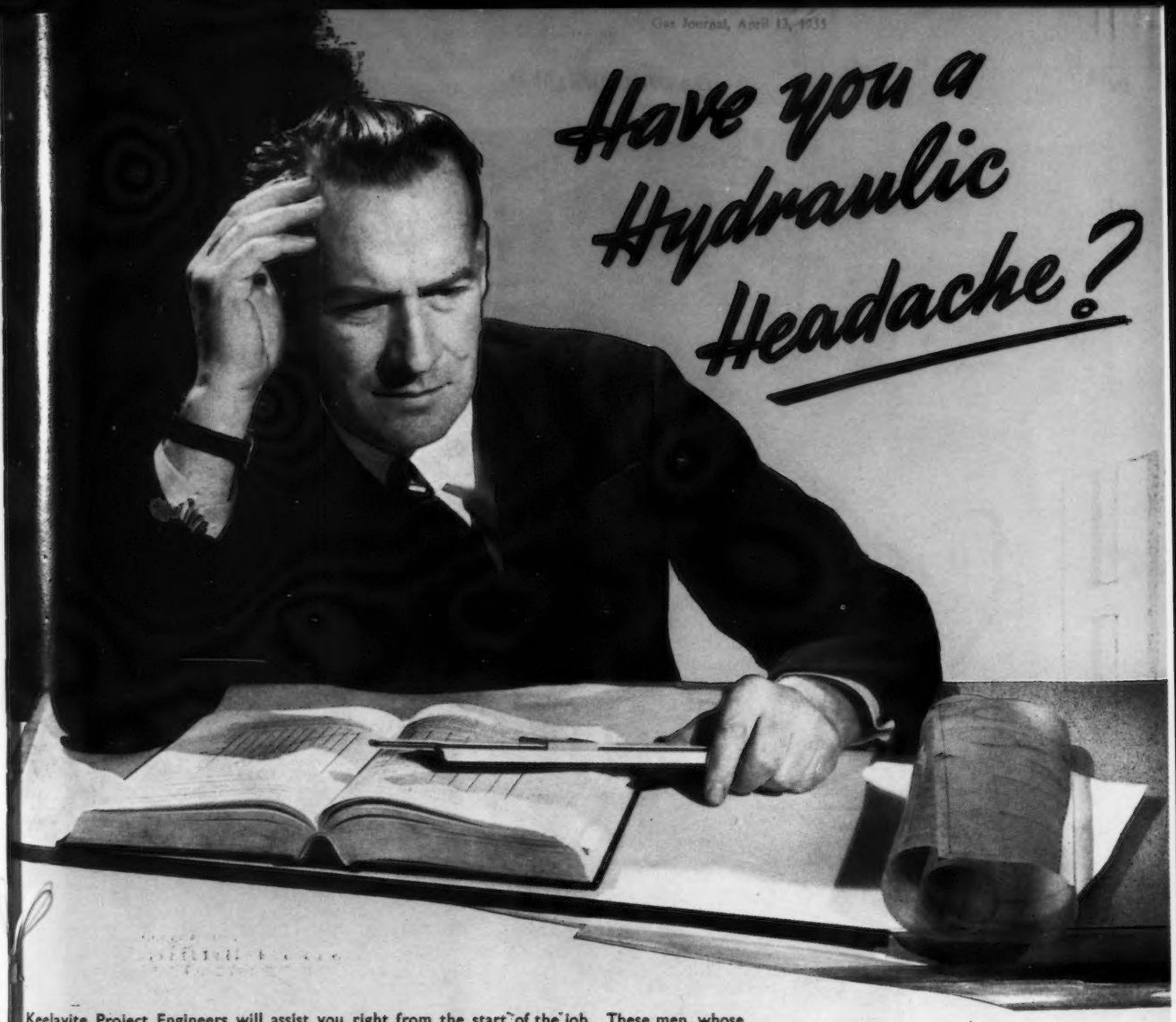

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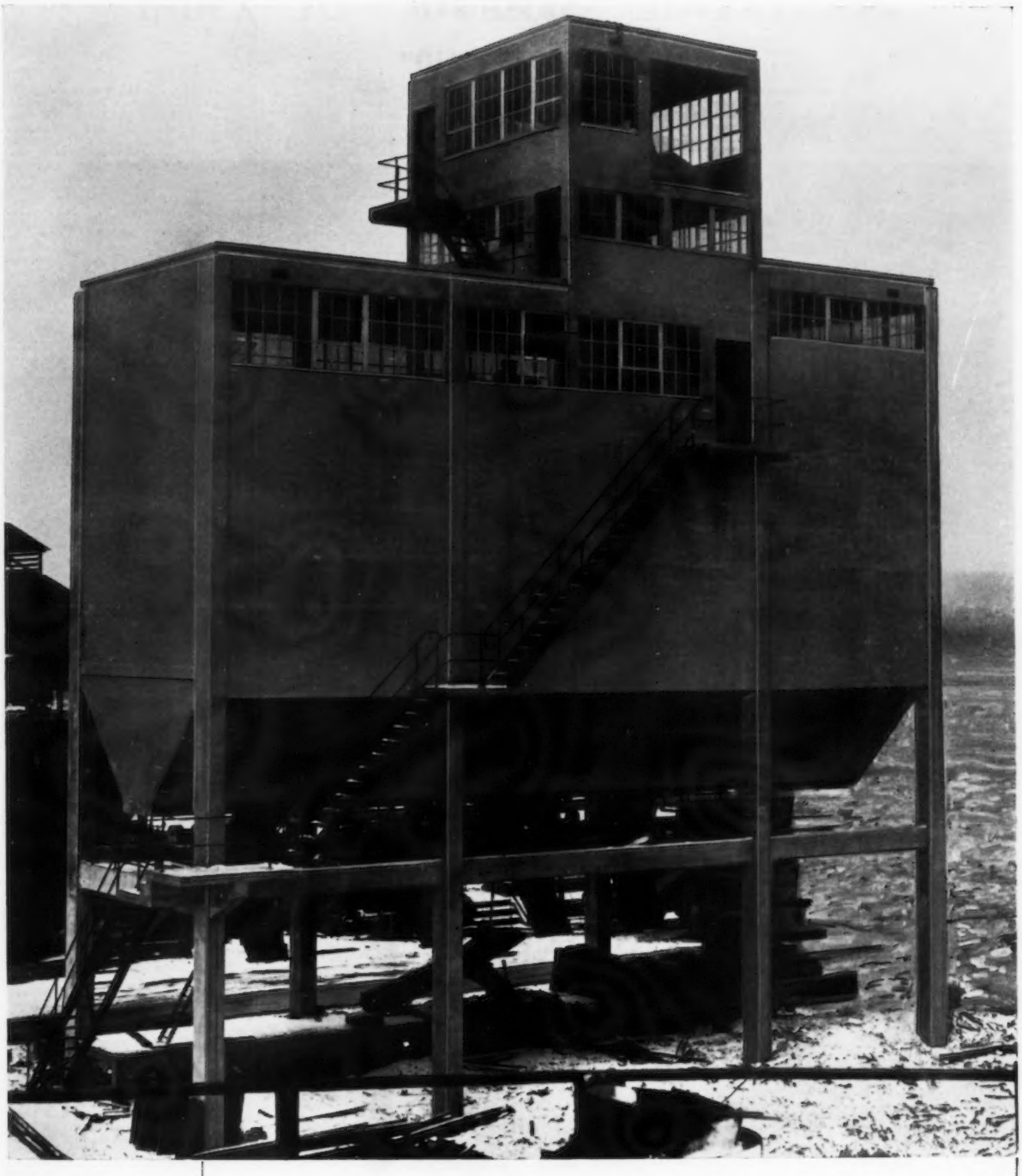

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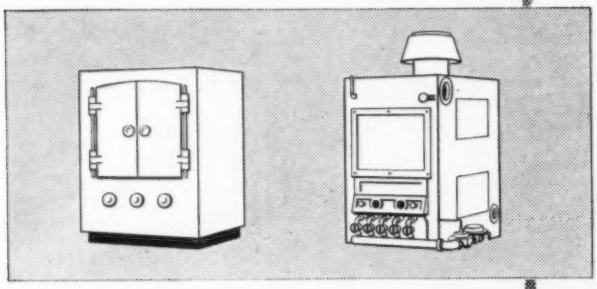

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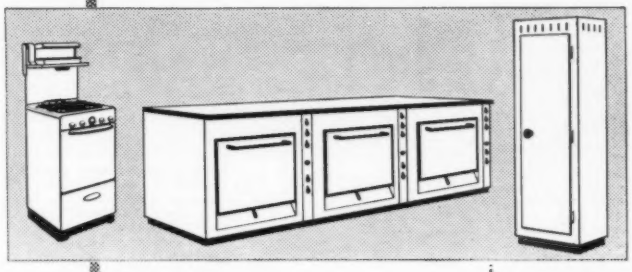

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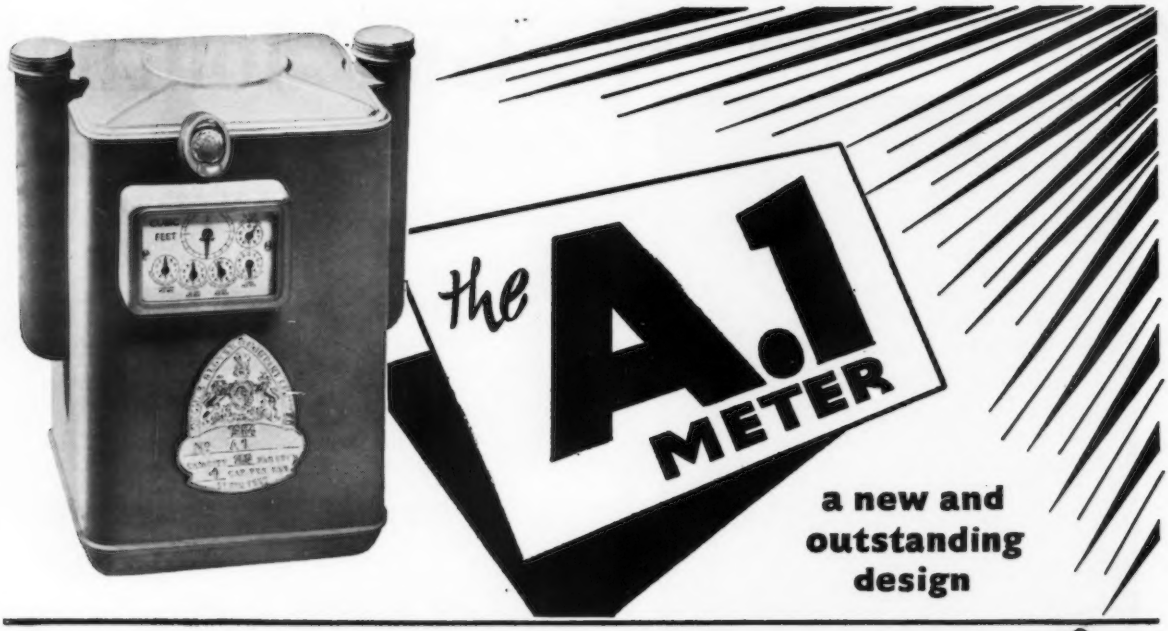

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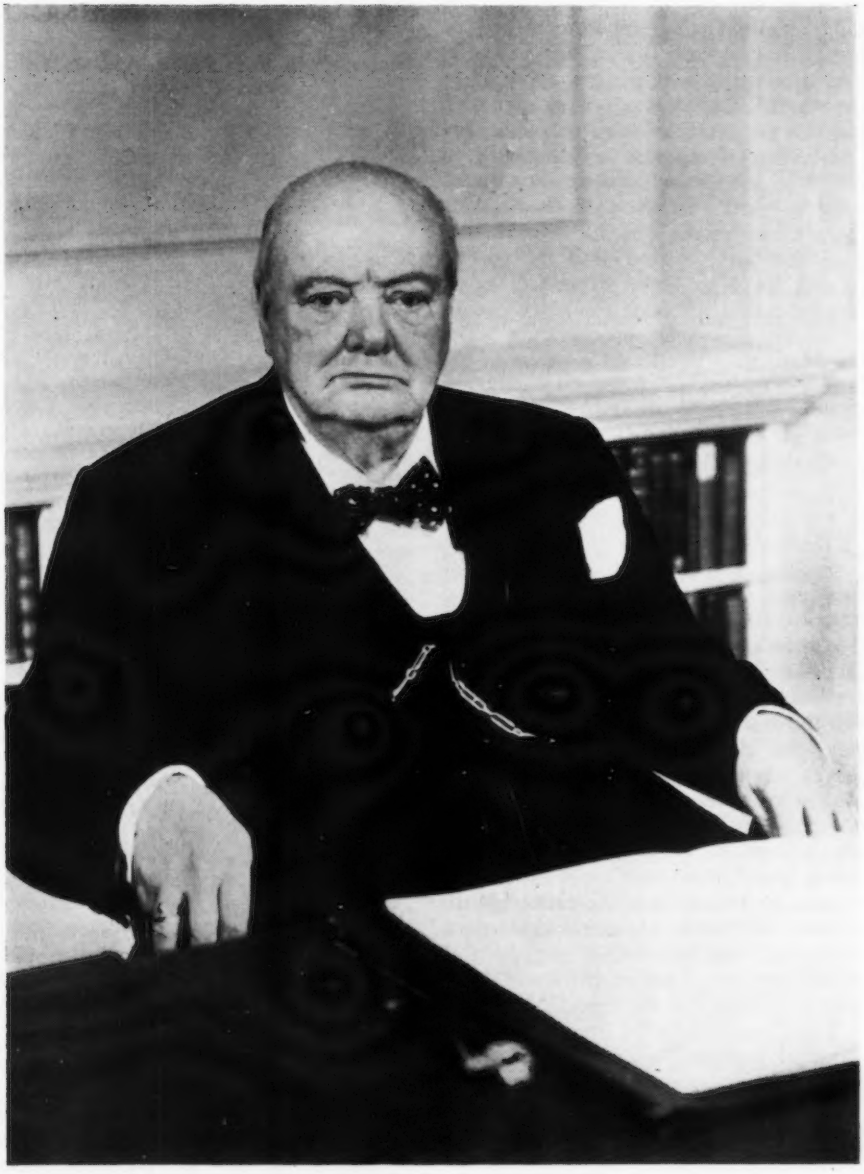
Gas Journal

VOLUME 282. No. 4793. APRIL 13, 1955. 107th YEAR



'PROUD TO SERVE'

Sir Winston Spencer Churchill, K.G., O.M., C.H., M.P., resigned the office of Prime Minister of Great Britain on April 5, 1955.

City and Guilds Institute

THE 75th report of the Council of the City and Guilds of London Institute for the year ended September 30, 1954, the first complete period of twelve months since the Institute changed its calendar, states that the chief event of the year was the launching of the ninth examining body now officially known as the Associated Examining Board for the General Certificate in Education. The establishment of the Board has been welcomed as one of the most significant developments in secondary education in recent years and a development which should prove to be of far-reaching importance in educational and industrial fields. The new body is the only one of the nine now examining for the General Certificate on which industrial and professional interests are directly represented. The Council has long realized the importance of the quality of intake to technological studies, and indeed in earlier days held examinations at preliminary level to ensure initial standards. The raising of examination standards alone will be of little avail if industrial recruits are unsuitable, unprepared, or insufficient in numbers. With these conditions in mind the Council decided not only to participate in the scheme as a sponsor, but also to be responsible for finance and administration in the initial period, and the cordial reception given and the high hopes expressed, augur well for a successful future, although too much cannot be expected in the first few years of operation. The Council looks forward to a significant increase in the next few years in the number of successful candidates and in the quality of those destined for productive industry.

The report of the Department of Technology shows that candidates examined at all centres at home and overseas in 1954 totalled 88,560 against 82,287 in the previous year, a healthy sign not only of the interest of individuals in securing a recognized qualification of national standing and repute, but also of increased facilities for technical education and training provided by education authorities and industry. It would seem that facilities for technical and industrial training are expanding, that employees are alive to the needs of the day, and that the maximum number of examination candidates which must eventually be limited by population has not yet been reached. Apart from the interests of industry itself, the Institute's gospel to the young is that the possession of a practical qualification is an investment, if not a life assurance, which should not be neglected in prosperous times.

Gratifying as these figures are as an indication of progress and expansion, they mean additional strain on a dispersed and ill-housed staff, and despite inspection of many premises and sites for a permanent home, none has yet been found suitable for the Institute's special requirements. The Council is much exercised by the question of a central institute building, but it seems unlikely that suitable premises will become available for two or three years, and interim arrangements, involving four separate office premises, are being made which will complicate the problem of administration and may in some degree affect the public relations of the Department of Technology. Dealing with finance, the report says industry has continued to respond generously to the appeal made by the Chairman of the Council in 1952. A sum of £20,276 was received during the year. Contributions to the appeal fund before September, 1954, amounted to £51,743. In addition, £49,013 (including repayments of income tax calculated at the rate of 9s. in the pound) receivable during the next six years had been promised by that date; the total of £100,756 received or promised would be smaller if the rate of income tax were reduced. While it would be invidious to refer to particular donors, attention is directed to the successful appeal by the President of the London Master Builders' Association which resulted in a total of £7,200 being received from or promised by 94 members of that Association, several of whom executed deeds of covenant. Such regular income is of vital importance to the Institute, and the report urges all friends of the Institute to promise regular subscriptions.

OUR NATIONAL HERITAGE

TWELVE months ago the National Benzole Co., Ltd., rendered a much appreciated service to the motorist and to the economist by publishing *Our National Heritage*—an illustrated guide to Britain's beauty spots with a very informative section on benzole production and utilization. It proved so popular that the Company was moved to follow it with more information in the same vein. Thus we were able to welcome, in time for the Easter holiday and almost our first glimpse of the countryside since the long and exhausting winter, *Our National Heritage II*, illustrating some 36 more beauty spots in England, Scotland, and Wales, and linking again our heritage of scenery and history with our heritage of coal and its precious by-products. The 36 places chosen for this book range from simple cottage to soaring cathedral, from mountain range to city street, but all, whatever their intrinsic beauty, share (with a million others there is no room to show) in Britain's rich and varied store of history, art, adventure, religion, prose, and poetry. Each is within reasonable motoring distance for somebody, and anyone who can visit all of them, perhaps on successive holidays, will have gained a fair insight into a cross-section of Britain's heritage and a store of memories of fascinating places. The last two pages bring us back to the scarcely less fascinating story of the production of benzole by the basic industries of Britain and recall that as far back as 1907 the motoring organizations recommended the use of benzole as a motor fuel. Who, then, can quarrel with the final comment in the preface: 'With National benzole mixture in the tank each beauty spot will be a few miles-to-the-gallon nearer.'

CASTING AND COSTING

THE British Productivity Council, with the co-operation of the several organizations which sponsored the Brassfoundry Productivity Team which visited the United States in 1950, has published, at 2s. 6d. a review of productivity in the bronze and brass casting industry which, from a technological point of view, has made great strides since the return of the Team. The industry suffers to some extent from a lack of large capital resources, which has imposed a handicap on developments by certain individual firms, but it is felt that the position could be improved by closer co-operative action. The trade and research associations, which are in a position to help member firms, are poorly supported and a large number of manufacturers appear to be content with a 'we have always done it this way' attitude. Brassfounding is the oldest section of the foundry

industry, with a history going back at least 4,000 years, but it is only during this century and principally since the war that practices within the brassfoundry have undergone marked changes. Until the new methods came to be adopted, foundry work, and in particular moulding, had been essentially the province of the craftsman, so that understandably, as in other traditional craft industries, there has been reluctance to re-scheme work hitherto performed by a skilled technician so that it can be executed by a semi-skilled or unskilled operative. Some of the technological processes developed since the war, together with recommendations for raising the efficiency of the industry on a broader scale, are described in the report. The adoption of shell moulding, aluminium-alloy match-plates, and the flexible and reinforced abrasive wheel are among the developments referred to. Stress is laid, however, on the necessity for the wider adoption of such general techniques as job simplification, which would leave the moulder free to concentrate on moulding instead of doing a wide variety of jobs; mechanization, even to the extent of a few yards of roller conveyor; work study; and the adoption of a suitable costing system. The review also urges the desirability of making foundries less unsightly than some of them are at present and also of ensuring that the prospects offered by the industry are more widely known.

An appendix contains a series of case histories of both jobbing and specialist foundries of all sizes in various parts of the country. The steps that have been taken by these firms to increase their efficiency vary to a considerable extent. Some attribute their advance to the adoption of new technical processes, some to new layouts and some to mechanization, while others again attribute it to the introduction of bonus incentive schemes or the use of work study. Much remains to be done to win fuller acceptance for new foundry practices, and the review urges that firms which have not hitherto been members of the industry's trade and research associations should join them.

REAL SERVICE OR LIP SERVICE

IT is a hard thing to say, but between the high-flown verbosities of those members of the industry who describe the excellence of the service provided to gas consumers, and the real facts which are only too familiar to those consumers, there exists a gulf as wide as the Grand Canyon. Our position at this office is a little peculiar in that on the one hand there arrive at our over-flowing desks papers and reports extolling the virtues of the gas boards and their salesmen, while at the same time we are the recipients of a remarkable number of hard-luck stories from consumers who have been banging their heads against the brick wall of gas board officialdom and cherish some hopes that we may be able to help them. Sometimes, indeed, it is possible for us to have a quiet word with someone in the right quarter and there is temporarily, at any rate, one less frustrated consumer.

In many ways the most dangerous cases are those which receive space—and frequently generous space—in our national newspapers. Undoubtedly some of these complaints are ill-founded and unfair, but not all. Take, for example, a letter published in the *Evening Standard* recently, written by someone whose water heater was out of action. The fault was reported to the local office of his gas board, which promised to send a man. When no-one came after ten days it was reported again. This time a man came, dismantled the heater, explained what needed to be done, and promised an estimate before the work started. Twelve days later 'a youth of about 16 called and said, reading from a piece of paper: "It will not cost more than 30s".' Not surprisingly, the consumer sent him back and asked for a written estimate. 'What a way to run a business!', he comments, and it is difficult not to agree with him. This is one example which could be quoted, and it is all extremely bad publicity for gas. There is little doubt that there exists a growing need for gas boards to take a closer interest in the impression they make on their consumers over matters which may on the face of it appear to be trivial, but which when spread across the newspaper headlines constitute a serious blow to an industry which, oddly enough, has always prided itself on the service it renders.

BRITAIN'S BEST BET

TO boost productivity is Britain's best bet, says Mr. Graham Hutton, Economic Consultant to the British Productivity Council and author of *We Too Can Prosper*, in a footnote to an article on productivity versus inflation in the March issue of the *B.P.C. Bulletin*. Our resources are greater now than at any time in the recent past, he says; more savings are available and they can be increased; new and better machinery is available; above all the indispensable 'know-how' is available, both in the boardroom and on the shop floor. Sir Ewart Smith has shown that we are moving appreciably in the right direction. But the raising of the Bank Rate shows that we have got to move faster. In a pamphlet issued as a supplement to the *Bulletin*, Mr. Hutton sets out a series of recommendations, as he did in his book, for management, for trade unions, and for the nation as a whole, and he goes on to say that only those who have had to study British industry from the inside can know what the Productivity Teams and the Productivity Committees have achieved in the short space of three years since their work became widespread. Not only have they cross-fertilized managements and unions by the team reports and the follow-up activity; they have also organized the circuit scheme of visits to works and plants by teams drawn from shop floor to top management levels, and exchanged with other industries besides that of the plant visited. And they have launched a nation-wide campaign to bring home to British industry and all engaged in it, and to the whole nation, our dependence for a sound, safe, and prosperous future on our common effort to raise our productivity. In the author's view our security and safeguard lies in pooling knowledge with competitors and in making the markets for our products wider and raising our *real* incomes by bringing costs down. We can only do that by self-confident enterprise and a readiness on all sides to bring all our work methods, of men and of machines, right up to date. 'We too can prosper'—*if we want to.*

'Mr. THERM THE MAGICIAN'

VERSATILE Mr. Therm has already appeared to us in many roles and he assumes his latest one especially for the children in the Gas Council's new booklet, 'Mr. Therm the Magician!' With a wave of his magic wand, he turns lumps of glossy coal into everyday things like telephones and dresses, fertilizers and scents, to mention but a few. He takes the children on a wonderful journey back to the beginning of the earth, when it was covered with nothing but trees and swamps. He tells them how coal came to be formed by trees falling down and being pressed into black lumps by more and more earth, and how it was eventually discovered by man who found he could burn it and use it to cook his food. With another wave of his wand, Mr. Therm brings the children nearer our time and tells the even more romantic story of the young man discovering gas by cooking coal in his mother's copper kettle. Written in very simple language and printed in large type this booklet is ideal for telling young children the exciting story of coal, gas, and coke.

Personal Notes

MR. J. V. KLEIN, Joint Managing Director of Compoflex Co., Ltd., began a three week visit to Continental markets on April 3. He is spending most of his time in Holland, Belgium and Italy.

MR. C. H. RILEY, Manager of the Penistone Gas Undertaking, who until 1949 was Managing Director of the Penistone Gas Company, has been appointed District Manager of No. 7 District of the East Midlands Gas Board.

MR. C. H. D. PICKERING, F.INST.F., and the HON. P. PLEYDELL-BOUVERIE, Joint Managing Directors of Calor Gas (Distributing) Co., Ltd., will leave England on April 15 on a business trip to Canada, Australia, and the United States, and will not be returning until May 23.

MR. J. YOUNG, Eltham, former Secretary of the Association of Engineering and Shipbuilding Draughtsmen, has been appointed by the Minister of Fuel and Power, to be a part-time member of the South Eastern Gas Board. The appointment will date from May 1.

MR. OSWALD NICOL, Gosforth, has retired after 51 years with the Northern Gas Board and its predecessor, the Newcastle and Gateshead Gas Company. For the past 14 years he has been Chief Showrooms and Publicity Manager. In the 1914-18 war, Mr. Nicol won the Meritorious Service Medal.

SIR FREDERICK J. WEST, Past President of the Institution of Gas Engineers, the Dock and Harbour Board Authorities Association, the Manchester Association of Engineers, and the Manchester Engineering Council, Past Chairman of the Manchester Ship Canal, Lord Mayor of Manchester in 1924-25, is to receive the Honorary Degree of LL.D. of Manchester University on May 11. The distinction is in recognition of public services.

MR. WILLIAM SUTCLIFFE, B.SC., has been appointed by the Northern Gas Board to be Divisional General Manager of its Tyneside Division, the offices of which are at Grainger Street, Newcastle-upon-Tyne. Mr. Sutcliffe's early training was obtained with the former Newcastle-upon-Tyne and Gateshead Gas Company, and after serving the Blyth Gas Company as Engineer from 1940 to 1948 he was appointed in 1949 as General Manager, and on nationalisation became Divisional General Manager of the Board's Blyth Division.

MR. E. H. G. HUGHES, formerly representative of Parkinson Water Heaters in the South Western area, has been appointed Area Manager of the Parkinson Stove Co., Ltd., for the East Midlands area. This area was formerly covered by MR. K. F. HOLLINGSWORTH, who will concentrate his efforts in the West Midlands area. The Herefordshire District of the West Midlands, which was formerly covered by MR. A. SADLER, Area Manager for Wales, will also be covered by Mr. Hollingsworth. MR. K. A. LEECH has recently been appointed Area Representative, and will assist Mr. E. CULSHAW, Area Manager in the North Western area.

MR. ARTHUR HIGGS, who, as already reported in the 'JOURNAL' is leaving his post as Industrial Gas Officer to the North Eastern Gas Board to become Assistant Industrial Gas Officer to the West Midlands Gas Board, was the guest of honour at a farewell dinner at the Hotel Metropole, Leeds, at which Mr. Norman Hudson, Chief Commercial Officer, on behalf of the staff of the Commercial Office, presented him with a case of fish knives and forks as a token of esteem. Mr. Higgs, in acknowledgment, spoke of the help and encouragement he had received from Mr. Hudson for many years. At an earlier farewell ceremony following the Industrial Gas Engineers' monthly meeting, Mr. R. H. Anderson presented Mr. Higgs with an inscribed self-winding wrist watch, conveying the best wishes of all industrial staff at the Board and the Groups. Mr. Higgs said that the present would always remind him and Mrs. Higgs of their very happy associations in Yorkshire.

Obituary

MR. J. T. ALLEN, A.M.C.T., of Lancashire Dynamo and Crypto, Ltd., died suddenly on April 2 at the age of 62. Mr. Allen had been with the Company in its Trafford Park works since 1910 when he joined as an apprentice. He entered the service department in 1914, was for a short period in 1927 head of the contracts section and in 1928 was made head of the service department, which position he held until his death.

Correspondence

IN DEFENCE OF YOUTH

DEAR SIR,—It may console 'A Junior' (Correspondence, last week's 'JOURNAL') to recall that some wise man has said 'Criticism is the art of praise.' In any case, he should know that old men, and old women too, give good advice in order to console themselves for no longer being in a condition to set a bad example!

Incidentally, Winston Churchill's advice to juniors is not to be sneezed at: 'Live dangerously. Take things as they come. Dread nought. All will be well.'

Yours faithfully,

E.M.

Earls Court,
London, S.W.5.
April 9, 1955.

Diary

April 14.—WALES AND MON. JUNIORS (SOUTH): Annual General Meeting. Porthcawl.

April 16.—SCOTTISH JUNIORS (EASTERN): Visit to the Dunkeld undertaking. Combined paper.

April 16.—LONDON JUNIORS: Visit to Kensal Green Works of the North Thames Gas Board, 2.15 p.m.

April 16.—YORKSHIRE JUNIORS: Address by L. W. Andrew, Director, Watson House. Leeds University.

April 19.—LONDON AND SOUTHERN SECTION, I.G.E.: 'Large Scale Carrier Gas Carbonization,' A. F. Grant and C. H. Lewis. Bishop Partridge Hall, Church House, Great Smith Street, Westminster. 2.40 p.m.

April 19.—MIDLAND JUNIORS: 'Purification,' F. Grocott. Staff Mess Room, Birmingham, 6.30 p.m.

April 20.—COKE OVEN MANAGERS' ASSOCIATION: 'Experiences in the Operation of a Collin De-Sulphurizing Plant,' T. H. Williams, Royal Victoria Station Hotel, Sheffield, 7 p.m.

April 20.—SCOTTISH G.C.C.: Gas Board Offices, 26, Drumsheugh Gardens, Edinburgh, 11.30 a.m.

April 21-22.—SCOTTISH ASSOCIATION OF GAS MANAGERS: Spring Meeting, Peebles.

April 21-23.—NORTH WESTERN GAS BOARD: Staff Conference, Morecambe.

April 22.—MIDLAND SECTION, I.G.E.: Annual General Meeting. Queen's Hotel, Birmingham, 2.30 p.m.

April 26.—INSTITUTION OF CHEMICAL ENGINEERS: 33rd Annual Corporate Meeting, May Fair Hotel, London, 11 a.m.; Annual Dinner, 7.30 p.m.; principal guest, the Duke of Edinburgh.

April 26.—MIDLAND JUNIORS: Annual General Meeting. 'Works Locomotive Tyres,' G. E. Palmer. Birmingham.

April 27.—MANCHESTER JUNIORS: Annual Dinner, Lonyford Hall, Stretford.

April 27.—NATIONAL BENZOLE AND ALLIED PRODUCTS ASSOCIATION: Annual General Meeting. Grosvenor Hotel, Victoria, London, S.W.1, 2 p.m.

April 28.—NORTH THAMES G.C.C.: Caxton Hall, Westminster. 2.30 p.m.

April 28-29.—WALES AND MONMOUTHSHIRE SECTION, I.G.E.: Spring Meeting, Tenby.

April 28-30.—EAST MIDLANDS GAS BOARD: Staff Conference, Skegness.

April 29.—LONDON JUNIORS: 'Subjective Response and Environment,' F. C. Smith. 178, Edgware Road, London, W.2. 6.30 p.m.

April 30.—WESTERN JUNIORS: Annual General Meeting and visit to works. Weston-Super-Mare.

May 3.—EAST MIDLANDS G.C.C.:

May 6-7.—SCOTTISH JUNIORS (WESTERN DISTRICT): Visit to Begwaco Meters, Ltd., Farnworth, Lancs., and to Partington Works of the North Western Gas Board.

Gas Quality Measurement*

By H. MELLORS, B.Sc., A.INST.P.,
Senior Physicist, Area Laboratories, West Midlands Gas Board.

ACCURATE measurement and maintenance of prescribed gas quality standards are not only necessary because the Gas Acts demand it for the consumer; they are a necessary basis for the gas industry's economic and productive efficiency. The term 'gas quality', so used, embraces all those properties of towns gas, prescribed or otherwise, which affect the consumer, and this paper deals with three of these properties: calorific value, hydrogen sulphide content, and specific gravity.

It is perhaps to be expected that the methods of measurement, particularly for calorific value, have developed and improved mainly by the initiative of the Gas Referees, from Professor C. V. Boys' calorimeter in 1905 to the mobile testing laboratory of the present Gas Standards Branch of the Ministry of Fuel and Power. This should not excuse the works engineer and chemist from taking more than an incidental interest in the practical aspects of 'gas testing,' and it is hoped that a description of some of the present day apparatus, test methods and errors will direct interest towards achieving the best possible practice.

Calorific value became the most important measure of gas quality when the Gas Act of 1920 gave authority for gas to be sold on a 'thermal' basis. The Act included a rather loose definition of calorific value, the interpretation of which was left to the Gas Referees. As a consequence the Gas Referees have prescribed procedures and conditions for producing official calorific values using approved calorimeters. [1,2].

Because of simplifying assumptions these procedures do not necessarily give absolute calorific values; but they do provide a standard of comparison which is in common use. With automatic usage, and the infrequent need for more accurate absolute values, the implications of these procedures are often forgotten.

Most calorimeters provide a figure for the 'gross calorific value', which is perhaps most simply defined in a negative manner by saying that net C.V. = gross C.V. less the heat of condensation of water vapour.

A comprehensive definition, given in the Appendix, embodies most of the variables (component and ambient conditions, etc.), which require correction and hence which are subject to errors in calorimeter tests. It is convenient to discuss these errors, which may be conditional, observational, or operational, in relation to the individual instruments, and to add comment on the Gas Referees' interpretation in each case.

Boys Non-recording Calorimeter

The water flow calorimeter was introduced by Professor C. V. Boys, as one of the Metropolitan Gas Referees in 1905, and with only a few minor modifications it remains the standard instrument for official testing in this country. Details of its construction will be well known. One of the main features is the heavy domed brass casting at the top of the combustion chamber which acts as the primary heat exchanger and as a temperature equalizing chamber for the outlet water. After a warming up period of about ¾ hour calorific value determinations can be made from measurements of the gas rate, the water rate and the rise in water temperature.

Gas Measurement

Gas rate is measured with a water-filled ½ cu.ft. Boys' bell meter or a modified Hyde meter. Both can be equally accurate. (0.1%), if due care is taken in filling with gasified water and in adjusting the water levels at the operating rate.

Official gas meters are calibrated and certified initially by the Ministry, against a standard 'cubic foot bottle', and then verified annually *in situ* by reference to a standard Hyde meter using a special meter comparator—and not now with reference to the original Harcourt meter prover. This does not preclude the works or area board from making their own confirmatory tests more often, in fact it is desirable that they should do so.

Some meters (commissioned or certified prior to 1937) may have been calibrated under back-pressure from a calorimeter burner, but present practice is to calibrate open to atmosphere, as a result of which inlet pressure must be taken into account when computing the gas volume factor and correcting to standard conditions. For 450 B.Th.U. gas, approximately 1 B.Th.U. error is introduced in the result for an error of 1°F. in reading the gas temperature or for an error of 0.05 in. in reading the mercury barometer. Incidentally, official testing practice omits to correct the barometer readings to 32°F., as required in the full definition of gross C.V. (so introducing a difference from the absolute value of approximately 1 B.Th.U. ± 0.5 B.Th.U. depending on temperature fluctuations).

Water Measurement

When making a test on the Boys' calorimeter the outlet water is diverted, by means of a changeover funnel, and collected in a calibrated glass measuring vessel during four revolutions of the meter. The volume is then read off, from the graduations, to the nearest division, that is to 2 ccs. (This is the Gas Referees accuracy requirement and is equivalent to 0.5 B.Th.U.) The need for careful and systematic draining of the vessel between tests is thus quite obvious.

By definition of the B.Th.U. this water volume should be converted to weight at 15°C. In practice the method of calibrating the vessel takes account of any density error at 15°C. and it is only necessary to correct to volume at 15°C. This is the expansion correction of water in relation to glass, and is ascertained from tables. It is usually equivalent to about − 2 B.Th.U.

The alternative method of collecting the water in an aluminium cannister and weighing on a special 'water weighing balance' results in a greater accuracy (equivalent to about ± 0.025 B.Th.U.), the only correction being one for the relative buoyancy of the water compared with the brass weights used in weighing. It is relevant to note that an accuracy of ⅛ second in timing the water collection is equivalent to about 0.5 B.Th.U.

Temperature Measurement

The temperature rise of the water is measured with thermometers ranged 0-50°C. and calibrated to 1/100ths. By using magnifying lenses it is just possible to read 0.01°C. (equivalent to 0.25 B.Th.U.). To be sure of this accuracy the thermometers must be tested periodically against a standard and provided with a correction certificate, giving overall correction for various types of error.

The Gas Standards Branch of the Ministry of Fuel and Power have established that the ageing of thermometers is a long process and zero changes of + 0.05 to 0.07°C. during the first three years are quite common. The effect of any such errors can be averaged out somewhat by periodically interchanging the inlet thermometer with the outlet.

An additional correction should be applied to allow for the non-immersion of the thermometer stems and this can be done from standard tables—it is usually equivalent to between 1 and 3 B.Th.U. For simplicity the Gas Referees procedure incorporates this correction by an increase (from 11.904 to 11.931) in the fixed multiplying factor used, at the end of the C.V. calculation, for standardizing the units of measurement. The accuracy of the method is dependent on good control of room temperature, the correction being slightly lower than it should be.

Heat Transfer to Effluent Gases

Heat may be lost to or gained from the effluent gases, giving rise to errors in the final C.V. figure of ± 5 B.Th.U. or more. The correction to be applied is dependent on the temperatures, water vapour content, and relative volumes of

* From a paper presented to the Midland Junior Gas Association on March 8, 1955.

the inlet air, gas and effluent gases. A general form of the correction (usually referred to as the 'humidity correction') is given in the Appendix. Humidities may be measured with a wet and dry bulb hygrometer while the relative gaseous volumes may be deduced with the aid of an analysis of the effluent gases.

The original and complete expression for the correction as introduced by the Gas Referees in 1915 (see Appendix) assumes an air/gas ratio of 7/1, and means that, in the Boys calorimeter where air inlet channels are fixed, the gas rate must be adjusted to give this ratio for the particular C.V. of the gas being tested. A change of 1 cu.ft. in the number of cu.ft. of air per cu.ft. of gas results in a change of approximately 0.5 B.Th.U. in the value of the correction.

Since 1920 the Gas Referees have used a simplified and empirical humidity correction given by:— $\frac{2}{5}$(effluent-air)°F. + 2 B.Th.U. For convenience the odd 2 B.Th.U. is incorporated, with the emergent thermometers stem correction, in the standard unit conversion factor, increasing it from 11.931 to its final value of 11.976 (i.e., 3 × 3.992). This simplified correction is accurate (to within ± 1 B.Th.U.) only over a limited range of air humidity and of inlet air and effluent gas temperatures. Hyde and Mills[3] give a useful table showing these limits of accuracy, and this should be consulted if results are suspect under particularly humid operating conditions.

Heat Exchange with Surrounding Atmosphere

Heat transfer between the calorimeter surface and the atmosphere depends on ambient temperature conditions and on the design and condition of the calorimeter lagging and surface finish. Fortunately, one of the advantages of flow calorimetry is that temperatures at various points in the system remain fairly steady, thus heat losses or gains are more consistent, and capable of compensation by adjustment of the external air temperature. Due to this heat transfer the Boys' calorimeter, which is lagged with felt and fitted with a chromium plated outer metal jacket, will give the following errors on 450 B.Th.U. gas :—

Inlet water and room at same temperature — 1.5 B.Th.U. low.
Inlet water 3°C. lower than room temperature — correct.
Inlet water 6°C. lower than room temperature—2 B.Th.U. high.

This clearly shows the importance of keeping a temperature difference of + 3°C. between the room and the inlet water, at the same time bearing in mind the need for minimizing other errors by keeping them both between 55-70°F. (The Ministry stipulate a range of 10-25°C.) In most cases this will mean heating the room, in others it may be necessary to preheat the water. These limits are particularly important for minimizing the neglected error due to change in specific heat of the water. As already mentioned the surface finish is most important and a dirty calorimeter will certainly 'lose' B.Th.U.

Overall Performance of the Boys' Calorimeter

To summarize this rather involved, and unavoidably monotonous description of the measurements and errors associated with the components of the Boys' calorimeter, one would expect well maintained equipment to have the following overall accuracy for determinations made according to the Gas Examiners' procedure :—

(1) A reproducibility of ± 1 B.Th.U. (on 450 B.Th.U. gas) for repeated tests on the same gas under the same operating conditions of the instrument.
(2) A reproducibility of ± 2 to ± 4 B.Th.U. for the same gas tested under different operating conditions.
(3) An absolute accuracy, i.e., in terms of true gross C.V., of between − 5 and + 4 B.Th.U.

Fairweather Recording Calorimeter

In implementing the Gas Act (1948) the Ministry of Fuel and Power have asked many undertakings—usually those with annual gas sales greater than 600 mill. cu.ft.—to provide continuous recording calorimeters for official testing. Two instruments are approved, the Fairweather and the Thomas.

The Fairweather recorder, which was invented by J. H. Fairweather of the Brentford Gas Company, is based on a modified Boys' non-recording calorimeter and incorporates automatic control of water and gas flows and continuous correction for tabular conditions (i.e., for changes in atmospheric temperature and pressure).

Thus if C = calorific value of the gas
W = weight of water passing through the calorimeter
V = volume of gas burned
T = temperature rise of the water
N = tabular number
and K = constant

then $C = K\frac{TW}{VN}$, V is constant, and the instrument operates so that the ratio W/N is also constant. A continuous record of the water temperature rise T, measured electrically by means of resistance thermometers, is therefore directly proportional to the calorific value C.

The gas supply to the calorimeter, after being governed down to about 3/10 in. W.G., is maintained at a constant rate of 5 cu.ft. per hour by means of an escapement release on the $\frac{1}{12}$ cu.ft. measuring meter. This electromagnetic escapement receives an electrical impulse every $\frac{1}{4}$ second from a master clock and allows simultaneous incremental rotation of the meter.

The water flow to the calorimeter is controlled by constant overflow-heads on either side of an orifice. The upstream overflow and hence the inlet pressure to the orifice is fixed but the downstream overflow floats up and down in the open limb of the 'tabular control', which is in effect a large constant-pressure air thermometer. The dimensions of this tabular control are such that, with correct level in the oil seal, the water flow V = 200 × the tabular number.

One great advantage of the Fairweather instrument is that a manual test of C.V. may be made on it in almost the same manner as for the Boys' non-recording calorimeter. The precautions and corrections already described for the Boys will apply, although it is usual to ignore the humidity correction because the inlet-air as well as the gas is saturated. (Strictly speaking this is only legitimate when the effluent gases are 3 to 5°F. above air temperature.)

The accuracy of the recorder relative to these spot tests depends on the accuracy of the tabular compensation and of the resistance thermometer recorder, and these factors must be periodically readjusted. The drift from one week to the next is normally less than 0.5%. In official testing procedure[4] the mean difference between the recorder reading and two spot tests taken during one visit of the gas examiner is combined with a similar figure for the previous visit and an average correction computed for interpreting the recorder chart during the intervening period. A similar correction is computed to allow for any change in the water content of the gas meter.

As with the Boys' calorimeter, the absolute accuracy of the Fairweather depends on the condition and accuracy of the various measuring elements, and, most important of all, on the room conditions.

The instrument requires a room with a minimum floor area of 100 sq. ft. and a minimum height of 11 ft.; preferably a room with cavity walls and no exposed windows except on the north side, so insulating it from exterior temperature changes. Ventilation is necessary to remove vitiated air and to provide a good temperature distribution throughout the room; four changes per hour are usually sufficient and any more may represent wastage of room heating. The room temperature should be 3°F. higher than the inlet water, in order to minimize radiation losses from the calorimeter and also to ensure the correct air gas ratio for the burner. If the room temperature becomes lower than the inlet water the flow of air to the burner will be erratic and probably reversed, ultimately causing the burner to go out. The room heating apparatus should therefore be thermostatically controlled; and the thermostat should have a proportional and not an on-off action. On-off heating sets up a thermal oscillation in the calorimeter or causes a cyclic variation in the record. For this reason electrical heating apparatus is not ideal. Hot water heating is the most adaptable for this application.

Recent developments of the Fairweather

One obvious disadvantage of the Fairweather is the size of the tabular column, necessitating a test room of greater than average height. A new type of compensator is at present under development and running tests. This compensator is a much smaller constant-pressure air thermometer, which by employing mercury as the manometric medium can convert tabular variations into a proportional electrical resistance change in the thermometer recorder circuit. Water flow can thus be kept constant.

The resistance thermometers are connected in Wheatstone bridge manner, and the present direct reading Elliot recorder normally fitted to the equipment uses a crossed-coil system

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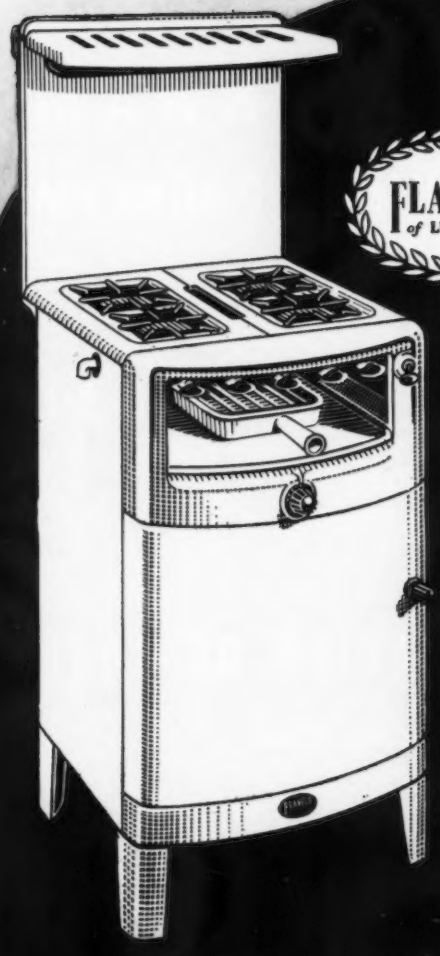

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to cancel fluctuations in the battery supply. This compensation is only accurate within limits. Mechanical or electronic self-balancing Wheatstone bridge ('potentiometric') recorders are independent of battery supply and have other advantages such as a wide scale and greater motive power for reliable operation of safety cut-outs or control equipment. These modified instruments are now available but have not yet been approved for official testing.

The Thomas Recording Calorimeter

The Thomas recorder was invented in America but has been developed for use in this country by the Cambridge Instrument Co., Ltd. The instrument is again a flow calorimeter, but the heat of combustion is absorbed by air instead of water. This heat-absorbing air, the gas, and the air for combustion are saturated at the same temperature and pressure and measured positively and individually in wet meters which are geared together and turned by an electric motor through a common shaft drive and reduction gearing. The three meters are arranged in a water tank covered by a lid, and the heat absorbing air and the air for combustion are drawn from the enclosed space above the water. By this arrangement the volumetric ratio of the heat-absorbing air, the air for combustion, and the gas, is independent of changes in temperature and barometric pressure, so avoiding the need for any automatic tabular compensator. The rise in temperature of the heat-absorbing air is measured with electrical resistance thermometers as in the Fairweather.

It is a disadvantage of the Thomas calorimeter that it cannot be verified without relation to an independent calorimeter, such as the Boys non-recorder. For the initial calibration of the instrument, the manufacturers change the air/gas ratic gearing and do a blank test on hydrogen. An electrical 'cold-balance resistance' on B.Th.U. coil, equivalent to an appropriate B.Th.U. change, is then provided for subsequent sensitivity tests on the electrical recorder.

Only three routine component tests are necessary: one on the mechanical balance of the electrical recorder, one for its sensitivity with the B.Th.U. coil, and one for the corrections of the absorbing air/gas ratio.

When using the Boys calorimeter for verification tests on the Thomas it is usual to apply the humidity correction in its complete form (see Appendix) to the Boys before making the comparison.

The accuracy of the Thomas has been thoroughly investigated by Jessop in America, where the instrument is widely used. It can be well within 1%. An interesting advantage of the Thomas over other calorimeters is its greater speed of response.

The Sigma Calorimeter

The calorimeters so far described are primarily designed for accurate measurements on town gas and they are of necessity somewhat elaborate and delicate in their construction, and, as we have seen, they require special operating facilities.

For measurements of C.V. under circumstances where these facilities are not available or where the same degree of accuracy is not required an inferential calorimeter is ideal, i.e., a calorimeter in which only a portion of the heat of combustion of the gas is measured but which is empirically calibrated in terms of gross C.V.

Various instruments of this type have been made and sold in the past, but the Sigma B.Th.U. recorder is now the most widely used. In this instrument gas is burnt at the bottom of two concentric steel tubes, the products of combustion setting up a differential expansion between them. This expansion is directly related to the thermal value of the gas and, by a suitable mechanical link mechanism, can be converted to a reading on a recorder chart.

The reading is kept reasonably independent of changes in the specific gravity in the gas and in the atmospheric pressure and temperature by means of a special governor-orifice-governor system. In effect, the upstream governor is at one height and controlled by one value of atmospheric pressure, while the downstream governor is in a lower position and so controlled by a slightly higher value of atmospheric pressure. Any variation of the ambient conditions affects the governors differentially and causes a change in the pressure difference across the gas flow orifice; the gas flow is thus adjusted in order to deliver approximately a constant mass to the burner. Recently the manufacturers of this instrument have introduced an additional barometric compensator which can improve on the compensation of these gas-flow regulators. These additional, and optional, compensators are fitted to the outer expansion tube of the heat exchanger and control the flow of secondary air to the burner in relation to barometric pressure. Their use is limited to calorimeters measuring gases showing C.V. variations not greater than 7% of the centre line value.

The long period accuracy of a typical fully-compensated recorder, range 360 to 540 B.Th.U., is about ±10 B.Th.U. on a 450 B.Th.U. gas. The short period accuracy can be much better than this and it is interesting to compare the distribution of errors for periods of 6, 12, and 24 hours. Such curves indicate how often a recorder of this type should be checked or corrected if a chosen accuracy is to be attained.

It is usual practice to check the Sigma against the Boys non-recording calorimeter and to adjust the pen reading or apply a mental correction accordingly. An alternative method, which has proved satisfactory in cases where a Boys is not available, is to check the reading on a cylinder of compressed gas of known calorific value.[6]

When considering the installation of a Sigma recorder, the most important requirement is a location free from draught and with sufficient ceiling height to avoid any temperature differences between the two regulating governors. Accuracy will of course be improved if room temperature is steady. The Sigma recorder has not, so far, been approved by the Ministry as being sufficiently accurate for the official determination of the progressive and quarterly average calorific values.

Portable Water-flow Calorimeters

The calorimeters so far discussed all consume gas at rates in the region of 2,000 ml. per min. By using soap-film flow meters, Gooderham has developed a portable calorimeter which consumes gas at a rate of about 25 ml. per min. and requires only 400 to 1,000 ml. of sample. This instrument avoids many of the usual errors by employing an adiabatic calorimeter, by saturating both gas and air for combustion and by simultaneous positive measurement of their volumes. By suitable adjustment of the relative values of air and gas a wide range of calorific values can be determined. Gooderham has claimed that an accuracy of 1 B.Th.U. is possible, but the operator would need to be very practised to achieve this. Routine results obtained on one of these instruments, without applying a correction for the emergent thermometer stems, etc., were found generally to be between 5 and 8 B.Th.U. low.

Donnelly and Broadbent[8] have published details of a similar portable calorimeter, of simpler construction, in which gas at 200 ml. per min. is burnt in oxygen, giving a result accurate to 1%. Both these calorimeters could be constructed by any competent glass blower.

Integration and Control of Calorific Value

Progressive C.V. averages are very useful figures in studying works operational efficiency and ultimately in providing the figure for the quarterly average. Opinions may be divided about the legitimacy of the official method adopted for averaging the records from recording calorimeters, but to obtain a mathematically correct (or statistical) average manually would be a lengthy business. A reliable automatic integrator might be the answer, but the basic errors of present instruments do not really justify a more rigorous analysis.

It may be of interest to add at this point a brief comment on C.V. control. There have been many ingenious adaptations of calorimeters for control purposes, that of J. W. Young[9] being a case in point, but undoubtedly the most successful and generally useful controller which is available commercially is the combination of a compensated Sigma calorimeter with a Kent Mark 20 air-operated control unit. (A very good description of the control unit itself has been given by Bevan-Lewis.[10])

Kenward and Lucas[11] have described the application of this equipment to the control of a mixture of horizontal retort coal gas and producer gas by dilution with waste gas from the retort house stack. The accuracy of control varied between ±4 B.Th.U. in winter and ±15 B.Th.U. in summer. The equipment has also been used successfully to control dilution with carburetted or blue water gas to ±2 B.Th.U.[12]

Provided that the control scheme is sound in the first instance, the main difficulties to contend with concern the time lags in the plant and in gas sampling. It is interesting to note

that Young uses a flat flame burner for assisting in manual control of calorific value and claims that plant adjustments can be detected in less than one minute. Perhaps someone will see in this the basis of a new automatic controller.

Sulphuretted Hydrogen

According to Statutory Instrument No. 792 the gas supplied by area boards must not contain sulphuretted hydrogen. It is officially considered to be present when a gas examiner can detect 'any trace' of a stain on a standard lead acetate paper exposed to the gas for three minutes in the Gas Referees apparatus. As is well known this apparatus is fitted with a governor-burner which passes gas at about 5 cu.ft. per hour. The sensitivity of the test is very dependent on the gas rate and may vary with different burners. It is of the order of one to two parts per mill. It may not be generally known that a modified and more portable version of this apparatus is now officially approved.

In common use for works purposes is the Hollings, Hutchison[13] method in which the intensities of lead acetate paper stains are measured by means of an optical density comparator. Various modifications of the method permit reasonable measurement of 0.01 parts per mill. and above.

Cooper and Thomas [14] have developed a continuous recorder in which a 1½ in. wide strip of lead acetate paper is repeatedly exposed to the gas and monitored with a recording densitometer. By using different gas rates and exposure cycles the recorder range can have any value from 1 to 200 parts per mill. of hydrogen sulphide in gas. A continuous strip of lead acetate paper exposure unit fitted with an automatic photo-electric alarm has been found very useful for safeguarding oxide purifier operations on one of the Birmingham gasworks.

Specific Gravity Measurement

The Gas Act of 1948 does not provide for the official testing of specific gravity of town gas, but this property has an important bearing on the efficiency of consumer appliances. Most works make daily spot checks on specific gravity using a Simmance gravity bell, by which the rate of effusion of a volume of gas through an orifice is compared with the rate of effusion of the same volume of air. With an instrument in good condition an accuracy of 0.5% can be obtained (e.g., ±0.0025 for s.g. 0.5). The South Eastern Gas Board seem to prefer the direct reading method offered by gas specific gravity balance of Hales and Moss.[15] This gives readings to ±0.002.

Reliable recording gravitometers of the floating bell type have been marketed for some years by Alexander Wright, Ltd., and Sigma Instrument Co., Ltd.

Readers will no doubt be aware of the Sigma Wobbe Index recorder (Wobbe Index = calorific value/square root of specific gravity), which has recently been publicised.[16] This appears to be a Sigma calorimeter fitted with a modified gas flow regulator. The range of the instrument is normally 500-1,000, with 600-900 as a minimum; it is consequently not particularly sensitive for observations in any one burner group.

Appendices

Definition of Gross Calorific Value

This is truly defined as the number of British thermal units produced by the combustion, at constant pressure, of 1 cu.ft. of gas measured at 60°F. under a pressure of 30 in. mercury (the mercury being at 32°F., the scale at 62°F., and under gravity equivalent to that at sea-level in latitude 45°) and saturated with water vapour at 60°F., with air at the same temperature and pressure, when the products of combustion are cooled to the initial temperature of the gas and air, and the water formed by combustion is condensed to liquid state the degree of saturation of the air being such as will ensure that the water vapour content of the entering air and gas is equal to the water vapour content of the resulting products of combustion.

Humidity Correction

A general expression for the heat gained or lost to the effluent products, as derived by Hyde and Mills, is as follows:— $H = [L(yc - (xa + b)) + ysde]$

where L = latent heat of unit weight of water at average air temperature.

a = weight of water vapour in 1 cu.ft. of air at the degree of saturation indicated by wet and dry bulb thermometers.

b = weight of water vapour in 1 cu.ft. of gas, saturated at the meter temperature.

c = weight of water vapour in 1 cu.ft. of effluent gases, saturated at the temperature shown by effluent thermometer.

d = weight of 1 cu.ft. of effluent gases under same conditions as c.

e = temperature difference, effluent gas minus air in °F.

x = volume of inlet air per unit volume of gas.

y = volume of effluent gas per unit volume of gas.

s = specific heat of unit weight of the saturated effluent gases.

N.B.—This expression assumes that the gas is saturated after passing through a wet meter if not before.

As a development of the above expression the General Notification to Gas Referees 1915 prescribed the following correction:—

$$H = 0.15\ [6.6c - (7a + b)] + 0.00022de,$$

this assuming an inlet air/gas ratio of 7 and effluent gases/gas ratio of 6.6.

The correction now officially prescribed for tests with the Boys calorimeter is quite empirical and approximately equal to 2/5 (effluent gas − air) °F + 2, the odd 2 being incorporated separately as a percentage correction in the standard unit conversion factor.

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ROYAL INSTITUTE OF CHEMISTRY

Although a number of points of detail remain to be settled, provisional agreement has been reached on the framework of a scheme for the extensive revision of the conditions of admission to the various grades of membership of the Royal Institute of Chemistry. According to the annual report of the Council for 1954, the scheme involves establishing a transitional non-corporate Graduate Membership grade, and replacing the exsting Associateship examination by a Graduate Membership examination to be held in two parts—Part I including theory papers (but not practical test) in inorganic, organic and physical chemistry at approximately pass degree level, and Part II having a content similar to that of the present Associateship examination (including practical work) and equivalent to but not identical with that for an honours degree. The scheme also involves making admission to the Part II examination conditional on having passed or been exempted from Part I and on having satisfied the requirements (to be somewhat modified) in ancillary subjects.

Admission to the Associateship will be made conditional on having passed Part II or been exempted from it—*e.g.*, on the basis of a first or second class honours degree in chemistry of a recognised university, and on having had subsequently a period of approved experience in the practice or application of chemistry. The scheme will require evidence of a suitable standard of professional maturity and responsibility as the essential condition for promotion from the Associateship to the Fellowship, and developing post-Associateship examinations (such as those now described as 'Fellowship' examinations in special branches) as leading to separate qualifications of the Institute (such as Diplomas in Applied Chemistry) not directly linked to the Fellowship.

Industrial Controls in the Use of Gas*

By I. M. PERL, Managing Director, Perl Controls, Ltd.

By 'industrial controls' I shall assume we refer to the means of controlling the use of fuel in industry, for the purpose of achieving the most efficient utilization of that fuel. One could discuss industrial controls for any or all of the fuels used in industry—gas, oil, electric, and solid—and one could look ahead and contemplate the shape of things to come in the age of nuclear energy, but for the purpose of this paper I shall limit my references to gas.

The control of fuel can, of course, be achieved either manually, or by means of *automatic* controls. The advantages of automatic control are so obvious that, these days, there are very few industrial processes in which it is not employed. The saving of man-power cost, the economy in fuel consumption, the prevention of material spoilage, the eliminating of accidents and resulting capital damage, not to mention the risks of personal injury, these all make an obviously strong case for the use of automatic controls, as they contribute to the more efficient utilization of fuel. And yet we come across gas-fired equipment used in important processes entirely devoid of any controls at all. When tackled, these consumers usually give one of three reasons: (1) They have never given the matter any thought—there are fortunately very few of this type; (2) they do not think that the initial capital outlay is justified; or (3) they have used controls at some time, and having experienced some sort of trouble, prefer to rely on manual control. It is up to the industrial representative to educate those in the first category to the advantages and, indeed, the necessity for using automatic controls, and to convince those in the second category that the initial capital outlay on automatic controls can, in most instances, be recovered in a single season in the form of saving in labour cost, material spoilage, economy of fuel, and so on. With regard to category (3), it is up to manufacturers, in the development and production of controls, to ensure that the consumer can unfailingly receive accurate and consistently reliable results.

There is a large variety of industrial controls in use, but for our purpose we may reasonably divide them into two main groups: (a) Temperature controls; and (b) safety controls.

Thermostatic control has been in general use now for the past 30 years, and it may be said that it is almost universally accepted as a necessity. It may be useful to touch on one or two views we hold, which are based on our experience in this field. As you know, subject to it being able to pass the necessary volume of gas, you can use a thermostat as direct acting, i.e., without a relay valve, so that the full volume of gas passes through the thermostat to the burner. In our view, this method should not be employed for industrial applications where a rapid recovery is called for, and where close limits and consistently reliable control are desirable and, indeed, often essential. Under industrial applications I include the commercial applications, such as the baker's oven, the fish fryer, many catering appliances, and so on. It will be readily appreciated that, in an application such as metal treatment in a salt bath, a critical close limit applies, both from the point of view of preventing spoilage of material, and obviating dangerous operating conditions. A fish fryer, for example, must have a rapid recovery of temperature following loading. For these, and numerous similar applications, in order to achieve accuracy and reliability, temperature control must be effected by the indirect thermostatic system, i.e., employing, first, a thermostat which is a scientific instrument, designed and manufactured with care for the job, and, secondly, the agency of a relay valve of good design.

Direct-acting thermostats are not designed for accurate, close limit operation. They suffice for operation in the domestic cooker oven, where a temperature variation of ± 25°F. (a total of 50°F.) is immaterial, but this mass produced 'bimetal' device, to which we cannot truly apply the term thermostat, cannot satisfactorily fulfil the requirements of the industrial or commercial job, which calls for a wide range of operating conditions. It certainly should not be thus used.

Another type which, though sometimes used for indirect control, should be employed with great caution for critical industrial applications, is the capillary thermostat, which relies on liquid expansion. When one considers the vulnerability of the bellows system, the possibilities of failure with this thermostat are understandably greater than with the rod type thermostat of comparatively simple construction, while the additional linkage frequently used in the former can, of course, lead to increased back-lash. Admittedly, it has the advantage that the thermostat head can be fitted in any convenient position, and for some applications, where accuracy and reliability are not critical, this thermostat may be suitable. On the whole, we do not recommend its use for industrial applications.

Single-burner and Multi-burner Control

Simple single burner applications are dealt with by the standard thermo-electric valve, such as the 'Thermoperl' and 'Junoperl,' the operating principles of which are by now well known. The 'Thermoperl,' the first of the thermo-electric series made by my Company, deals with gas consumptions up to 900 cu.ft. per hour, or 1½ in. gas supply. The 'Junoperl,' which followed, operates on exactly the same principle and has exactly the same performance in every respect. The design of this valve and its ancillary pilot burner was simplified to provide a set at a price more reasonably comparable with the price of the appliance to which it was to be fitted. Though it is made for ½ in. gas supply, its maximum rating at 0.3 in. w.g. pressure drop is as high as 160 cu.ft. per hour.

Originally the thermo-electric set and, indeed, the electronic set, were limited to single burner applications. The problem of applying flame-failure control to multi-burners, i.e., burners which are too widely spaced apart to cross-light safely and with certainty, was very acute not so long ago, and we set about grappling with this. The first thought that occurred to our technical department was that one valve should be employed in a manner that would make it responsive to the action of any one of a number of pilot burners. Deeper investigation into the matter, however, convinced us that the most reliable and satisfactory results could be obtained by methods which did not depart in any sense from the basic, well-established thermo-electric principle. This explains why we developed and produced the following alternative solutions for the multi-burner problem:—

(1) *The 'Perl' Bridging Ladder Burner. No. 101.*

The coupling of the various main burners in a common combustion chamber to a single pilot burner by means of a ladder burner is a well known principle; the provision of a ladder burner, the flame of which is perfectly stable, enables this principle to be applied in practice. Single point thermo-electric flame-failure controls, such as the 'Junoperl' or 'Thermoperl' sets can thus be applied to multi-burner control problems with full confidence, and at comparatively low cost.

This ladder burner is a ribbon flame gas burner of novel design, spreading ignition with certainty over a number of bar burners from a single pilot burner. Thus, a single thermo-electric set can be employed to protect a number of widely spaced main burners in a common combustion chamber. A small quantity of gas is distributed evenly along a slit in the outer tube, by means of the novel inner tube, where control of the gas rate takes place. The chief applications are box ovens, boilers including conversion sets, conveyor ovens,

* From a paper presented to the Eastern Junior Gas Association at Lowestoft on March 16, 1955.

etc. It is very suitable where automatic control ancillary equipment is employed. The burner is provided in sections 24 in. long, which can be coupled to provide a ladder burner of any reasonable length, thus making the sections of universal application to any appliance. A 36 in. initial length is also available. In standard form provision is made for the ribbon flame only, the burner being drilled on installation with jet holes to provide a projecting ignition flame coincident with the main burners.

(2) *The 'Junopilot' Set No. 30.*

This is a double action thermo-electric valve of neat and attractive design, and its cost is very low. Two shut off valves are combined in the one body, i.e., the shut off valve for the main gas supply, and the shut off valve for a pilot gas supply, both shut off valves being isolated completely from each other, so that pilot burners can be kept going at full pressure when, for some reason, such as thermostatic control, the pressure in the main body is negligible. On flame-failure, however, all gas is shut off. Without departing from accepted principles of operation, the 'Junopilot' valve has a number of important applications. One is the control of multi-burnered appliances where combustion chambers are isolated from each other. Hitherto, where a thermo-electric valve has been applied to each burner bar, and group burner control is required, e.g., thermostatic, the pilot gas supply, which must necessarily be taken from in front of the relay valve, has been unprotected. The 'Junopilot' valve ensures that the pilot supply also is shut off on flame-failure. The maximum rating of the valve for operation directly in the main burner supply is 160 cu.ft. per hour.

Weep Control

As a general principle the control of a large gas supply by the medium of a thermo-electric valve fitted in the weep of a relay valve is not recommended. It will be appreciated that should a leak develop in the weep line between the relay valve and the thermo-electric valve a dangerous condition could be set up. Nevertheless, because of the relatively low cost and as many installations are already fitted with a relay valve for thermostatic or similar control, such an arrangement is in common use. It is for this reason that we strongly recommend and emphasize that where a thermo-electric valve is thus employed, the weep line between the two valves should be of a solid and permanent nature, e.g., British standard pipe screwed permanently into the respective gas connections.

It will be clear that where a thermo-electric valve is used for weep control it need only be of small size, i.e., only large enough to pass the small supply of gas flowing through the weep line. The pilot supply, which must be taken from in front of the relay valve, is not normally controlled. For such cases we consider it quite superfluous and confusing to fit the conventional double seated type of thermo-electric valve, and we have developed the single seated 'Miniperl' Set. No. 10. This is small, neat, compact, and inexpensive, and for weep control does all that the more costly, more complicated, and larger set does. Its pilot burner is non-aerated, and fully adjustable to suit individual conditions.

With the 'Junopilot' Set No. 30 it is, of course, possible to control the pilot supply always, even when weep controlling. In such an arrangement, the pilot gas could not be protected hitherto without the use of a second thermo-electric valve. Though control of a single pilot burner may, in many instances, be deemed unnecessary, it becomes of great importance where a bridging ladder burner is to be used in conjunction with a relay valve on a large gas supply, becoming in effect an additional pilot burner of appreciable gas rate.

Another point worth mentioning is that these days, electric thermostats are often used for gas-fired apparatus. In such cases, a magnetic gas valve acts as the agent between the gas supply and the electric control. A small magnetic gas valve is sometimes fitted in the weep of a relay valve. The alternative method is to fit a magnetic gas valve of appropriate size in the main supply. The Perl type No. 60, 2-way magnetic gas valve for the main supply is unique in operation and is considered to be an advanced system, incorporating many important advantages. Later it will be shown how it also acts as a safety control.

Let us now consider safety controls, under which are included a group popularly, though somewhat incorrectly, referred to as 'flame-failure controls'. We prefer to call them, ignition and combustion protection controls. The term 'safety' should be avoided, as it can lend a sense of false security to the operator, who often imagines that, once a 'safety' control is fitted, he may ignore every common-sense procedure in operation, e.g., a correct lighting-up sequence. True, he may suffer no harm, but he will also prevent the plant from coming into operation. Until recently, authoritative treatment of the subject of flame-failure control was necessarily confined to laying down general principles. While this served as a guide, it was not sufficiently wide in scope to clarify a rather confused overall conception unhappily prevalent in the mind of the installation engineer. He was, therefore, not in a position to advise correctly a none-too-receptive consumer.

Some seven or eight years ago, the Board of Trade, on account of exchange considerations, prohibited importation of flame-failure controls from the United States. At the same time the Ministry of Labour's factory department were pressing for the introduction of protective measures for gas-fired equipment in industrial premises. This uncovered the dearth of suitable flame-failure controls. During this period numerous gas-fired appliances of large rating were installed either without protective controls, or with devices which gave inadequate or no protection, and, indeed, in some cases became a potential source of danger. In this chaos only one course was open; manufacturers in this country would have to develop and produce safety controls of an acceptable type and to an acceptable standard.

In 1948 the department in the Ministry of Labour concerned with the safety of factories, working closely with the industrial departments of certain gas boards, published a booklet entitled 'Safety in Design and Operation of Gas-heated Ovens and Furnaces.' The guidance given was necessarily on broad lines, because there had been little field experience at that time. Recognizing that accidents from flame failure practically all occur during the ignition period, they listed as acceptable forms of controls, those that complied with the essentials: (a) That they give complete protection during the ignition period; (b) that they cut off the gas supply within a reasonably short period after the occurrence of a flame failure; and (c) could fail only to safety.

As a first-aid measure, until suitable flame-failure controls became available, a hand reset type valve, which cuts off the gas supply in the event of a pressure failure, was accepted, the argument being that it was better to have some measure of protection than none at all. Two systems of controls about which there was some experience, as they had been previously imported from the United States, were specially recommended These were the thermo-electric type and the electronic type, neither of which had been produced in this country. It soon became evident that both types had their particular applications. Broadly speaking, the thermo-electric type, with which was associated a cut-off time delay of up to 60 seconds, was better suited to the lower rated and less costly installations, such as the medium size and smaller drying oven, baker's oven, etc. There was a case for the use of the much more expensive electronic system on the more costly installations which were usually of larger gas rating and where even a short delay in the cut-off time became a consideration.

In the early part of 1948 my Company produced the thermo-electric type in this country. Our original set introduced no new principles, on the contrary, it adhered rigidly to established and proved principles, though it was considered that the many constructional modifications we introduced gave practical advantages in the use of the set.

Gas Council Report

Soon after a number of types and makes of flame-failure controls became available and in the interests of standardisation the Industrial Gas Development Committee of the Gas Council prepared a report. This laid down, in a much more definite form than anything before, basic essentials which must be incorporated in flame-failure controls. The report, 'Flame-failure Devices—A Review of the Present Position,' circulated in 1951, said, 'Every flame-failure device must: (a) Entirely prevent gas from being supplied to the main burner until the pilot flame is established; (b) if fitted correctly be free from an inherent weakness in design which will give rise to failure and danger; (c) after flame failure, completely stop all gas flow to the appliance, and require manual re-

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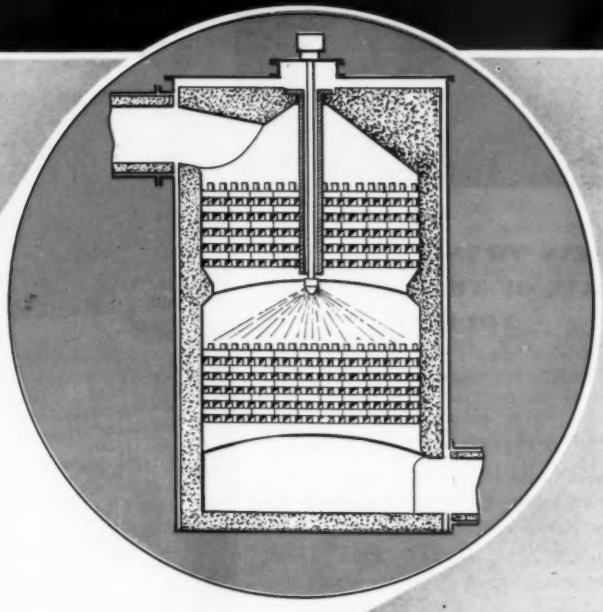

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setting; (d) be actuated only by a properly established pilot flame sited to ignite the main burner without failure or delay; (e) where it incorporates a gas-carrying component, have an approved capacity within a permitted pressure loss.'

As was to be expected, due to new developments, this report became partly out of date by the time it was completed. Furthermore, it could not possibly embrace and meet complications from numerous individual applications and difficult operating conditions. (I believe that a revised up to date report is in the course of preparation and will be available shortly.) It was obvious that having been given a valuable guide by the Industrial Gas Development Committee, it was up to manufacturers themselves to develop variations of and accessories to their standard products, satisfactorily to cope with all types of operating conditions.

I believe that many new and useful developments have taken place in the electronic field. In the thermo-electric field I can speak with first-hand knowledge. I consider that our developments are all to some practical purpose, and the cumulative effect of them will, I hope, satisfy many more applications than has hitherto been possible and incidentally to establish the confidence of a very sceptical consumer in the efficacy and reliability of flame-failure controls.

Thermostatic/Safety Control Combination

As an example of an industrial control which combines the functions of thermostatic and safety control, I shall introduce the Perl temperature limit and overheat control, No. 202, sometimes referred to as the fusible link control, a development of the North Thames Gas Board in association with our thermo-electric control.

This control is a positive operating cut out device, for use where a supply of gas is to be shut off in response to the attainment of a set temperature in an appliance. It consists of a short link of fusible metal placed in the appropriate position in the appliance and inserted in the thermocouple circuit of a 'Thermoperl,' 'Junoperl,' or 'Junopilot' thermo-electric flame-failure valve. When the melting point of the link is reached, it fuses and breaks the circuit, thus causing instanaeous shut down of the valve. At the same time, the function of the thermo-electric valve as a flame-failure device is maintained. Hence two features in one control are obtained with the introduction of the device. Once the link has fused, the thermo-electric valve remains closed, until the link is replaced, and the normal lighting procedure is carried out. The control is therefore useful in industrial processing, where, for example, the contents of an oven are to be taken up to a certain temperature, the gas shut off, and the oven allowed to cool. It is also invaluable where overheating of an appliance may be dangerous, such as a steam tube baker's oven, or a vat of inflammable liquid. It can be used here to cover a possible failure of any thermostatic control which may be fitted to the appliance.

Electric/Gas Combination

I must make reference to one of the improvements effected in the application of the electronic system for flame-failure control. As is well known, in order to support the feature of instantaneous cut-off with the electronic set, the magnetic valve which must be employed as an ancillary unit must control the main gas flow instantaneously on interruption of the electric circuit. To control the pilot supply also, yet another, though smaller, valve must be employed. For this reason, we developed the 'Perl' magnetic gas valves, types Nos. 60 and 70. From the following short descriptions it will be seen that though these are not in themselves flame-failure controls, they are nevertheless important accessories in this field. The general application of these valves is for gas-fired equipment used in conjunction with electrically operated controls or accessories.

Type No. 60.

This valve gives the advantage of almost instantaneous shut down, but with a very smooth action. It is absolutely silent in operation. Costs can be cut and undue loss of gas pressure avoided by grouping a number of controls, e.g., thermostatic control and flame-failure control onto one magnetic valve. For such usage the No. 60 valve has the advantages that it will shut down rapidly enough to take advantage of the rapidity of operation of the electronic flame-failure controls, and yet smoothly enough to avoid the nuisance and danger of shock waves being set up in the main gas supply under the frequent opening and closing to be expected with thermostatic control. Not so well known perhaps, is the fact that this valve can be fitted with a weep choke screw, as used in the standard gas relay valve, so that it can fulfil two entirely separate functions.

Some of the important and desirable features incorporated in the valve are: almost instantaneous shut off in the event of electrical interruption; a smooth action which eliminates shock pressure waves; absolutely silent operation; a positive electric control without the possibility of sticking; it cannot fail except to safety; the re-opening period being adjustable it ensures smooth and silent burner ignition; by reason of being one self-contained unit, it can be installed at little cost and is neat in appearance.

Type No. 70.

This is a robust plunger type of low wattage (8 watts), solenoid valve, available in $\frac{1}{4}$ in., $\frac{3}{8}$ in. and $\frac{1}{2}$ in. B.S.P. sizes. It is silent in operation. Its construction further ensures complete freedom from sticking in the open position. In standard form it operates on low pressure gas, but high pressure types are available to operate up to 5 lb. per sq. in. It is made suitable for standard or non-standard voltages, can be supplied for complete shut off, or high/low operation and can have special interior finishes to withstand certain corrosive gases. Where an electronic control is used for flame-failure control, the No. 70 valve is most suitable for pilot control.

DISCUSSION

The President, **Mr. R. F. Robinson,** opened the discussion by congratulating Mr. Perl on the able presentation of a paper which held great interest for all those members of the Industry concerned in industrial controls.

Mr. F. C. Cox (Norwich) reiterated the remarks of Mr. Perl concerning the close control necessary with such a highly refined fuel as town gas, and felt that the action taken in the sphere of other fuels in the question of controls was a compliment to those who had paved the way with industrial gas controls. He asked whether proper devices were available to safeguard electrically operated gas controls against the failure of electricity supplies.

Mr. Eves stated that in all reputable gas controls there was automatic failure to safety when the electricity was cut off. In the case of fans and like devices linked with gas plant, the failure of the elctricity supply automatically cut off the motors concerned.

Mr. Robinson asked if the makers of industrial controls were confident that their products were 100% gas tight and if positive action could always be relied upon.

Mr. Perl replied that whereas all reputable controls such as valves were gas tight, the possibility of the entry of foreign bodies into valve seats, etc., could always be a contributory cause of failure of any valve to operate correctly. He instanced cases where swarf from the thread cutting of steel pipe and filings from the joints of copper pipe had been known to be blown on to valve seatings. He therefore asked industrial gas engineers to ensure that the maximum possible attention be given to cleanliness in jointing and other fitting operations.

Mr. E. W. Martin (Ipswich) asked if the author would state whether the 'Miniperl' No. 10 could be fixed in any other position than upright.

Mr. Perl said the 'Miniperl' No. 10, as with all thermo-electric valves, could be fitted in any position. This same rule applied to most others, except that with an upside down fixing there existed the possibility of condensate in a gas supply trickling into the control, causing difficulty in the lighting-up of appliances.

Mr. E. S. Dennis (Ipswich) enquired whether there existed controls which could positively maintain an even temperature to $\pm 3°$F.—he had in mind the control of temperature in a Fairweather calorimeter room.

Mr. Perl said the question of maintaining an even temperature throughout the room depended upon air distribution in that room. With a fan able to produce rapid stirring of the air an ordinary room thermostat should give a control of $\pm 1°$F.

Mr. H. R. Lawrence of Luton proposed a vote of thanks to the author.

APPLIANCE RECONDITIONING*

By N. T. VOCE, Group Repair Shop, York.

WHILE the selling of new appliances is of paramount importance many older appliances are often required for further use. With suitable treatment by reconditioning or renovation these older appliances can be made not only to give efficient service but also to have an attractive appearance. The York-Harrogate Group of the North Eastern Gas Board has excellent facilities for carrying out this kind of work in its group appliance repair shop at York.

The types of appliances dealt with include cookers, radiators, fires, refrigerators and water heaters. It is not proposed to discuss water heaters in this paper as most of the work carried out is more in the nature of repairs rather than renovation.

The stages through which all appliances pass are: reception; preliminary inspection; dismantling; cleaning; painting; re-assembling; adjustment; final inspection and labelling for temporary storage or for despatch.

Fig. 1. A view of the spray booths in the paint shop.

Before describing the actual processes of reconditioning gas appliances it is proposed to give a description of the appliance repair shop. In the first place all appliances are brought to the reception yard and are booked in, inspected and labelled as necessary.

Stripping and Cleaning Shop

There are two 500-gal. immersion-heated tanks in this shop. Three Selas tube-firing burners are fitted to each tank with a full-on gas rate of 670 cu.ft. per hour per tank, the time taken to raise the temperature from overnight being 1½ to 2 hours. Each tank has an air agitator fitted to give movement to the liquid in the tank thereby ensuring a circulation over the material suspended in it. One tank is used for degreasing and contains a 5% solution of a caustic based alkaline degreasing agent which has to be maintained at a temperature of between 160°F. and 180°F. The other tank contains water and is used as a hot rinse. There are metal baskets 3 ft. by 6 ft. by 3 ft. high to hold the work passing through. Two of the baskets are divided into three compartments so that three stripped, that is, dismantled, cookers can be dealt with at the same time without mixing of parts. There is also a 100-gal. degreasing tank containing a 5% solution of caustic free degreasing agent for use on any work of aluminium construction. By the side of the tanks is a washing down sink 2 ft. by 6 ft. Over the tanks and the sink is a Morris Monorail with 20-cwt. lifting tackle for handling the metal baskets in and out of the tanks.

For the removal of any stubborn paint from cast-iron-framed fires which cannot be dealt with in a reasonable time in the degreasing tank there is a gas fired furnace 5 ft. by 4 ft. heated by four 1-in. Aeromatic burners with a full on gas rate of 528 cu.ft. per hour. The furnace is also used for descaling burners, top bars, etc., and as preheating furnace for any large cast iron welding work that has to be carried out.

Paint Shop

Installed in the paint shop are two spray booths fitted with centrifugal fans to extract all spray fumes to the outside atmosphere (Fig. 1). The usual spray guns with pressure regulators are fitted to the booths. An electric compressor and air storage cylinder provide the necessary air at 120 lb. per sq. in. A dipping tank for the painting of top bars, grid shelves, etc., is also installed. Two treble-casing stoving ovens of different sizes, to accommodate different types of work are provided. One oven, 6 ft. by 5 ft. by 6 ft. high internal measurements is thermostatically controlled with a full on gas rate of 240 cu.ft. per hour. The other oven is 4 ft. 6 in. by 4 ft. by 5 ft. high internal measurements, is manually controlled and has a full on gas rate of 225 cu.ft. per hour. Both ovens have thermometers fitted in the door panels. Finally there is a lead lined acid tank containing a 5% solution of 'Jenolite' rust removing acid.

Erecting Shop

The work bench in the erecting shop is arranged round three walls to ensure most effective use of daylight. Equipment includes two bench drills, one portable drill, one pedestal grinder and two portable grinders (one equipped with wire brush and polishing mops), sited in suitable positions. Portable wooden platforms 2 ft. by 4 ft. by 15 in. high are provided to stand cookers on during erection thus saving unnecessary lifting and bending on the part of the operator and speeding up the work considerably. A section of the erecting shop is also fitted up for the testing and repair of water heaters, etc. Additional equipment includes a guillotine, rollers, the usual tin shop equipment and a welding hearth.

Space is provided for the storage of the renovated work pending its despatch to our own district or to other districts.

Dismantling and Reconstruction of Cookers

When a cooker is off-loaded in the reception yard it is thoroughly inspected to see if it is complete and to note any badly worn linings. It is then taken into the stripping shop where it is dismantled. The insulation or asbestos packing is placed in a bin ready for re-use when the cooker is erected. The thermostat, governor, door knob and all screws, etc., are stored in a suitable tray. These are labelled with the name and address of the consumer and held pending the re-erection of the cooker. The dismantled cooker parts are placed in one compartment of the metal basket already described. Three cookers are dismantled and placed in the basket at one

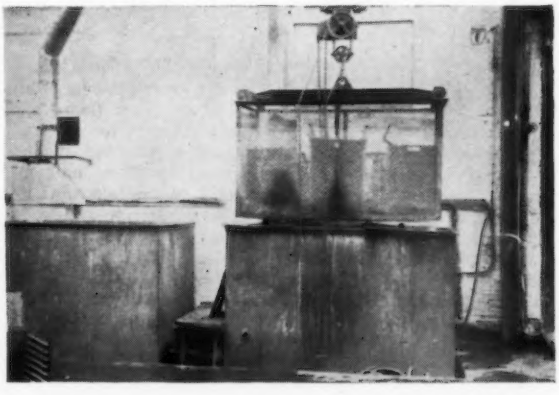


Fig. 2. Three cookers being lowered in basket into degreasing tank.

* From a paper delivered to the Yorkshire Junior Gas Association on March 12, at Wakefield.

time. The basket is lowered into the degreasing tank which as stated previously is maintained at a temperature of between 160 and 180°F. for twenty minutes allowing the degreasing fluid to remove the grease without giving it time to attack the enamel (Fig. 2). The basket is then lifted out of the solution and allowed to drain into the tank after which it is transferred into the hot rinse for five to ten minutes to remove the adhering alkaline solution.

The basket containing the three cookers is removed from the hot rinse, drained and lowered at the side of the sink. Each part is removed and scrubbed under running water and staked to drain off. As each complete set of parts is washed off it is taken into the erecting shop and placed on a shelf with the metal tray containing the parts. The cooker linings are re-examined and if the cleaning now shows them to be badly worn the consumer is notified so that new linings can be fitted if required. Any parts requiring painting such as burners and top bars are taken to the paint room so that they may be available when the cooker is re-erected.

The taps, the thermostat valve and by-pass, and the governor seating are cleaned and the diaphragm oiled. The cooker is then built up and repacked with the asbestos or other insulation packing as the case may be.

When completely assembled the cooker is taken to the test bench and connected to the gas supply. Here it is regulated and any minor adjustments that may be necessary are carried out. The cooker is then placed in the storage department, the labels examined for special despatch instructions and arrangements made accordingly.

Fires and Radiators

Here again the appliances are thoroughly inspected in the reception yard for damage or special instructions before passing into the stripping shop. They are then dismantled and if not of aluminium construction are placed in the metal baskets and lowered into the degreasing tank at a time when no cookers are being dealt with. With fires and radiators the work of the degreasing tank is to remove all trace of paint, so a longer period of time (in the solution) is necessary than with cookers. Generally about 1½ to 2 hours' immersion is required at 160 to 180°F and longer at lower temperatures. Unless the job is urgently required the customary procedure is, therefore, to place appliances in the solution after the normal day's work is completed and leave them overnight, thereby avoiding interruption of the cooker cleaning programme and also saving gas. When the appliance is of aluminium construction the paint is removed with liquid paint remover.

While the work is in the degreasing tank the fire refractories are washed down, any cracks repaired with plastic fire cement and then brushed over with a thin suspension of fire cement. The burners are stripped and cleaned and given a coat of paint, all governors are stripped, seatings cleaned and the diaphragm oiled. Chromed fittings are examined and if necessary sent for rechroming.

As soon as the paint is loosened on the appliance it is washed down under running water and brushed with a wire brush to remove any trace of rust. With all paint-finished appliances care must be taken to see that the cleaning operation is thorough to ensure good paint adhesion later. With this object in view the appliance is placed in a bath containing a 'Jenolite' rust removing solution where it remains from five to ten minutes. It is then drained off and placed in a stoving oven maintained at a temperature of 200°F. for 15 minutes, after which it is allowed to cool off and is rubbed down and is ready for painting.

To obtain the best result the painting should be carried out immediately after the rubbing down. Incidentally, it has been found that this treatment has been very satisfactory, and while the finish has been improved the cost is little if any greater, as appliances which were left for a short period after the normal cleaning required at least the time taken in the special treatment to remove the oxidation which had been formed.

One other important feature of this treatment is that the solution removes the particles of rust in the fine pinholes of the castings which cannot otherwise be removed and which are one of the sources of trouble later.

The operation of paint spraying is carried out as follows:—

(1) Apply one coat Phosphor Etch Primer and stove for 30 minutes at 200°F.

(2) Apply two coats of finishing colour. Each coat stoved for 30 minutes at 200°F.

(3) Finally apply one coat clear lacquer and stove 30 minutes at 200°F. (as before).

The appliance is then built up, placed on the test bench, connected to the gas supply and regulated as necessary. After this it is placed in the storage department ready for despatch.

Refrigerators

Owing to the relatively high cost of reconditioning such large units as refrigerators it is important that a very careful examination of the cabinet is made in the reception yard. Should the steel sheeting be found to be in a satisfactory condition for reconditioning the cabinet is sent to the stripping shop. If the steel casing is badly corroded and a satisfactory recondition cannot be guaranteed the owner is informed before the work is commenced and his instructions are awaited. In the stripping shop all chromed fittings, hinges, lock latch, etc., are removed and if the chroming is damaged the parts are sent immediately for re-plating to ensure them being ready by the time the refrigerator is painted. Top plate, door, feet and the plastic door facing strip are removed. The door is dismantled and the outer door plate, top plate and feet are placed in the degreasing tank and left until the paint is removed. Owing to its construction the refrigerator body is not dismantled but is treated with liquid paint remover.

When all paint has been removed from the body it is rubbed down with carborundum paper and then wiped over with a neutralizer to kill the paint remover. This treatment is followed with a brush application of rust remover. The outer door plate, top plate and feet when taken out of the degreasing tank pass through the hot rinse and are washed under running water then rubbed down with carborundum paper as for the body. To ensure a completely clean surface these parts are next placed in the 'Jenolite' solution tank and left for five to ten minutes. They are then taken out, drained off and placed in the stoving oven and maintained at a temperature of 200°F. for 15 minutes. After cooling they are rubbed down once more.

As has already been said the construction of the cabinets include wooden frames which rules out any process needing stoving or other heat treatment, unless the cabinet is completely dismantled and the panels dealt with separately. Therefore it is our practice to use an air drying paint the procedure being as follows:—

(1) One coat Phosphor Etch Primer is spray applied and allowed to air dry. This gives a very adhesive coat to the metal and has proved to be invaluable on this type of work.

(2) One coat red oxide cellulose paint is applied.

(3) Filling stopping is applied to any pinholes or small dents, allowed to harden and then rubbed down with both wet and dry carborundum paper.

(4) Three separate applications of finishing cellulose colour are applied, paying particular attention to getting satisfactory thickness on all curved surfaces. The first two coats are rubbed down with wet and dry paper after each application. After the last coat of cellulose has dried the cellulose is polished with a liquid polish.

The refrigerator is then built up, connected to the gas supply and tested, after which it is placed in the storage department ready for despatch.

DISCUSSION

Mr. D. C. Henderson, from the Chair, opened the discussion by congratulating the author of the paper, not only on his interesting paper, but on the care and attention his department put into their work in order to ensure a high grade quality finish in paintwork. He asked if the author had any experience with the triochlorethylene plant for degreasing, and instanced cases where black cookers had been painted over amateurishly by householders with oil bound paint and this was removed after ten to twelve minutes exposure. Earlier treatments also included the applications of caustic solution with a brush which enabled the linings and exterior to be washed down with a fine water jet without the need of dismantling. Mr. Henderson, referring to the cost of Mr. Voce's cleaning system, asked

whether he did not consider the gas consumption on the 500 gal. immersion tank which required 1½ to 2 hours to reheat, to be rather costly.

Mr. Voce replied that all the figures in his paper were maximum consumption and not average. The gas consumptions quoted were the full-on gas rates, but actually the heating of the tanks was thermostatically controlled. The tanks were only lit up when there was plenty of work on hand, and the work on appliances from various districts was systematically arranged for and carried out.

Mr. C. G. Broome suggested that the triochlorethylene plant also had a heavy gas rating, and that trouble had been experienced with fumes affecting the operators. Also the cost of the triochlorethylene was high.

Mr. Voce was questioned by **Mr. Armstrong** and **Mr. Place** of Leeds, who inquired (1) if there was a standard charge for reconditioning a cooker, (2) whether a temporary loan of an appliance was made while a customer's cooker was being reconditioned, and (3) how long did it take to recondition a cooker.

Mr. Voce said the normal charge for a gas cooker was £2 12s. 6d., and the customer, if he wished it, could have the temporary loan of an appliance while his cooker was being reconditioned, and when an appliance was collected for reconditioning early in the week, the customer could have the cooker returned cleaned and reconditioned before the weekend since what the Board was offering was a five-day service.

Asked what man hours were put into the reconditioning of a domestic refrigerator, Mr. Voce said it depended on conditions, but generally twelve to fourteen hours was given to the L.22—four to five for stripping, eight for painting, and two to three hours for stripping and finishing the door and reassembling. The renovation of a cooker took approximately eight hours.

Mr. F. Roberts, Bradford, asked Mr. Voce if his department was kept employed full time on the reconditioning of cookers and refrigerators.

Mr. Voce said his department was kept steadily employed with work from York one day, Harrogate on another day, and so on, but he should mention that they also did a good deal of renovating apparatus for resale.

Mr. G. Griffiths, Bradford, asked if Mr. Voce's repair shop was specially planned or equipped to enable him to recellulose or re-enamel appliances without getting them dusty or dirty again, and Mr. Voce replied that they had no difficulty with cellulosing as the shop was kept reasonably clean and dust free, and to do this they swept up regularly, often sprinkling water on the floor to keep dust down

Mr. Armstrong, Leeds, said that in their re-conditioning department they stove enamelled instead of cellulosing as in their place, owing to dust, they could not always get a satisfactory finish.

CONFERENCE ON CHEMICAL ENGINEERING IN EUROPE

Organized jointly by the Department of Scientific and Industrial Research and the Institution of Chemical Engineers, an O.E.E.C. conference on 'The Functions and Education of the Chemical Engineer in Europe' was held at Church House, Westminster, on March 21-23, under the Chairmanship of Sir Harold Hartley, President of the Institution of Chemical Engineers. Summing up at the close of the conference, Sir Harold said the three main objectives were the necessity for more chemical engineers and more schools of chemical engineering in the universities and technical colleges; the necessity for more financial aid for chemical engineering research both in universities and technical colleges and in specialized laboratories supported by Government and industry; and the necessity for a more general recognition of the part that chemical engineering is bound to play in modern industry.

There was general agreement among the European countries represented as to the conception of chemical engineering as a fourth primary technology which now took its place alongside the other professions of civil, mechanical, and electrical engineering; that view was shared by all the countries of the British Commonwealth. That was the first major result of the conference. The second was to show that there was a large unsatisfied demand for chemical engineers and consequently a need to expand and multiply the schools of engineering in each country. For the third they must rely on their friends of the Press and he hoped their nomenclature had not been too technical to obscure the main issues.

His own impression of the conference was that it had been one of the happiest he had ever attended, thanks to the spirit of its members. They had good papers, short crisp speeches, often punctuated by wise-cracks greeted quickly by loud laughter which showed how they were all on their toes. He observed no slumber or snores, but there was rapt attention. And only once had the chairman to touch a speaker on the arm, most appropriately in this case, as he was speaking of 'knowing when to stop.' He had enjoyed the happy, friendly atmosphere of the meetings, which was such a good omen for future co-operation. It was almost the first international conference on chemical engineering. He recalled the first International Chemical Conference held nearly a century ago in Karlsruhe. It was in the dark ages of chemistry when the various formulae for a simple substance like acetic acid could cover a whole page. It was not such a happy conference as this and it was reported that they separated in rather a chilly atmosphere of disagreement. But they took with them Cannizarr's little pamphlet which resulted in a reform that was badly needed. On the present occasion they would separate in an atmosphere of warm friendship and carry away happy memories and three volumes of transactions full of experience and wise comment. His belief was that the conference would make a great contribution to European co-operation in the field of chemical engineering.

INDUSTRIAL SAFETY

Sir Walter Monckton, Minister of Labour and National Service, formally opened Britain's first Industrial Health and Safety Centre on March 22. The Centre is to contain a permanent exhibition of methods and appliances for promoting safety, health, and welfare in industry. It forms part of a campaign by the Ministry of Labour to solve problems of industrial health and safety, which are estimated to cost the country over £10 mill. a year. Mr. Harold Watkinson, Parliamentary Secretary to the Ministry of Labour and National Service, presided at the first meeting of the Industrial Health Advisory Committee on March 18. The committee is to advise the Minister on measures to further development of industrial health in work places covered by the Factories Acts. The Parliamentary Secretary said industrial health services in factories covered the provision of a good working environment, protection against occupational diseases and poisoning, and adequate first-aid treatment of injury and sickness. Practical tasks before the committee included the determination of priorities for action in the field of industrial hazard, among which were dust and fumes, dermatitis, and radioactivity.

BRITISH COKE RESEARCH

The British Coke Research Association has just published its report of the proceedings at the sixth conference of the Association, held at the Royal Society of Arts, London, on October 28, 1953, and presided over by Mr. G. W. J. Bradley. The conference considered the theoretical work carried out on behalf of the Association during recent years. Three papers were presented—by Dr. H. L. Riley on 'Coke Formation: A Macro-polymerization Reaction'; Professor W. F. K. Wynne-Jones on 'Combustion and Reactivity of Carbon'; and Dr. R. A. Mott on 'The Effect of the Physical and Chemical Properties of Coke on its Combustion'—dealing with work accomplished at the Northern Coke Research Laboratories and at the Midland Coke Research Station of the British Coke Research Association. Results of studies of coke formation and structure were discussed, present knowledge of the reactions of carbon were reviewed, and the basic physical properties of coke were considered in relation to practical application.

Western Juniors' First Visit to Cornwall

In spite of counter attractions afforded by television and radio, covering the Boat Race and the Grand National, some 30 members of the Western Junior Gas Association travelled through rain and thick mist to visit the Bude works in Cornwall on March 26. The I.V.C. installation at Bude was completed in 1951, but was originally destined for Tiverton. Consequent on nationalisation in 1949, it was realized that Tiverton would become integrated with Exeter, and that gas making would then cease at Tiverton. It was decided, therefore, to transfer the plant designed for Tiverton to Bude, to replace the old horizontal retort house.

Members were able to visit sections of the plant with Mr. R. Miller, Technical Representative of W. J. Jenkins and Co., Ltd., the contractors for the project who was able to explain certain points relating to the plant, and to answer technical questions. Members were also able to see the new 400,000 cu.ft. holder erected by Robert Dempster & Sons, Ltd., which has given the station an adequate storage capacity.

At the conclusion of the works visit, members reassembled at the Efford Down Hotel, to hear Mr. Miller present his paper entitled 'The Bude Contract' (which we hope to publish in a later issue). In opening the discussion, Mr. J. W. Dean, Divisional Engineer and Manager, Plymouth and Cornwall Division, asked the author to enlarge on the question of the snags and difficulties encountered not only in the construction of the plant, but also in the initial operating stages.

Mr. F. G. Craxford (President) referred to Mr. Miller's connection with the old Bath Gas Company, and stated that Mr. Miller would be missed in the south west when he took up his new appointment in Retford very shortly.

Mr. L. A. Ross (Bristol) proposed a vote of thanks for an interesting paper, which had stimulated a lively and useful discussion.

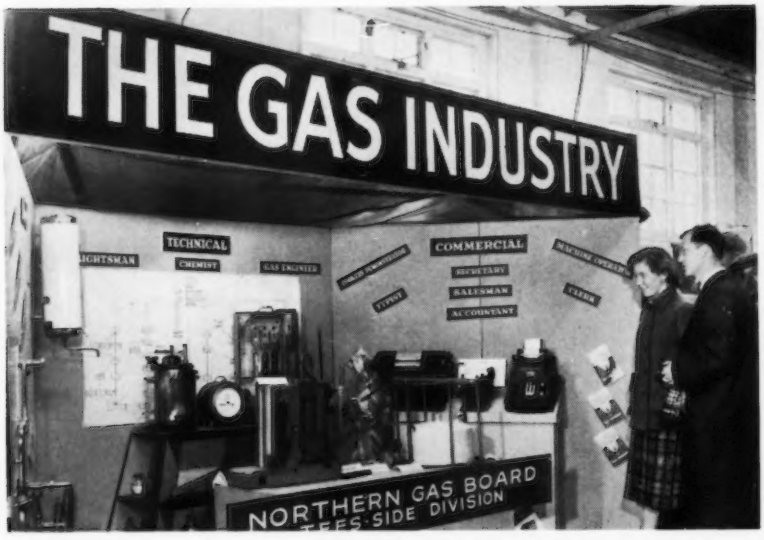
EXHIBITION AT LLANGOLLEN

An exhibition of domestic gas appliances recently held by the Wales Gas Board at Llangollen aroused considerable interest and was largely attended. The exhibition was officially visited by Mr. E. Garner Evans, M.P., and members of the Llangollen Chamber of Trade.

SCOTTISH JUNIORS AT GOTHIC WORKS

Members of the Scottish Junior Gas Association (Western District) photographed during their recent visit to the Gothic Works of R. and A. Main, Ltd., at Falkirk. The visitors, who were accompanied by their President, Mr. G. Roydon, and Mr. G. Campbell, Transactions Secretary, were welcomed on behalf of R. and A. Main, Ltd., by Mr. C. A. Macleod (Sales Director), Mr. F. Dyson (General Manager), and Mr. W. P. Rae (Northern Sales Manager). After being joined by their guides the party were shown the many processes involved in the manufacture of domestic and industrial gas appliances.

GUISBOROUGH CAREERS EXHIBITION



The gas stand at the Careers' Exhibition organized by the North Riding Education and Youth Employment Committee.

The Careers' Exhibition organized by the North Riding Education and Youth Employment Committee, at Guisborough, Yorkshire, from March 16 to 18 was officially opened by Mr. C. M. Wright, Chairman of Wilton Council, Imperial Chemical Industries. It was well attended by both schoolchildren and adults.

Great interest was displayed by the local education authorities, who arranged visits, including many parties by 'bus, from all schools in the Cleveland area. The scholars themselves showed a very keen interest in the gas industry stand which portrayed the technical, commercial and trades aspects.

The stand illustrated various pieces of accountancy equipment, laboratory and drawing office apparatus, together with samples of the fittings and appliances installed by the Board's apprentice gasfitters.

The handbook on the exhibition described the careers open to young people in the gas industry and, together with the stand, aroused particular interest and praise in the local Press.

Coke Sales Circle

Through the courtesy of the British Portland Cement Manufacturers, Ltd., and the South Eastern Gas Board, two parties consisting of 30 members each of the London and Counties Coke Sales Circle, visited Johnson's Cement Works at Greenhithe, Kent, on March 15 and 22. On each occasion members were entertained to luncheon by the South Eastern Gas Board, and then proceeded by 'bus to the works, where they were taken on a conducted tour.

Members were shown the manufacture of cement from the raw materials through the various processes of blending the clay and other basic contents with water; removal of moisture from the material by drying in a form of revolving furnace which attains a heat of 1,400°C., and finally pulverizing the cement from clinker form. The tour lasted nearly two hours, after which tea was provided by the British Portland Cement Manufacturers, to conclude an instructive and interesting visit.

Suggs Increase of Capital

The authorized capital of William Sugg & Co., Ltd., was increased from £117,564 to £300,000 at an extraordinary general meeting on April 5. The greater part of this increase will be absorbed by the issue and paying up in full of 114,632 £1 shares which will be issued to shareholders registered on April 1 in the proportion of one new share to each share then held. After the issue, a balance of capital of £70,736 will remain in hand which it is not proposed to issue at present. It was also resolved at the meeting that the £1 shares should be sub-divided into four shares of 5s. each unnumbered.

The Board stated that the reasons for these changes are that they consider the issued capital should be brought more into line with the balance sheet values of the assets. The sub-dividing of the £1 shares into 5s. units is intended ultimately to improve what is now a restricted market. A new company, Sugg Solar, Ltd., was formed on March 14 as a subsidiary of William Sugg & Co., Ltd., with an authorized capital of £150,000, to manufacture in England and market in the United Kingdom, Europe, and the Commonwealth countries, with the exception of Canada, the American Solar Aircraft Company's Mars gas turbine engine. The Solar Aircraft Company is a shareholder in this subsidiary, and the Directors of Suggs expect that this new activity will make a substantial contribution to the expansion of the Company's business.

DOCTORS AT BRATT COLBRAN WORKS

The Medical Officer of Health for the Borough of Wembley, Dr. E. Grundy, M.D., M.R.C.S., D.P.H., is teaching doctors from the London School of Hygiene, who are studying for the qualifying examination for the Diploma in Public Health of the University of London. The Government's clean air policy forms an important part of Dr. Grundy's syllabus, and in order to give the doctors some practical insight into the principles of design and manufacture of smokeless fuel appliances burning gas and coke, a visit to Bratt Colbran's Wembley Works was arranged for March 16. Our photograph shows Dr. Grundy (extreme left at rear) with his party of doctors in the Bratt Colbran Technical Laboratory while they were being addressed by Mr. H. Watts on the subject of safety in appliance design.

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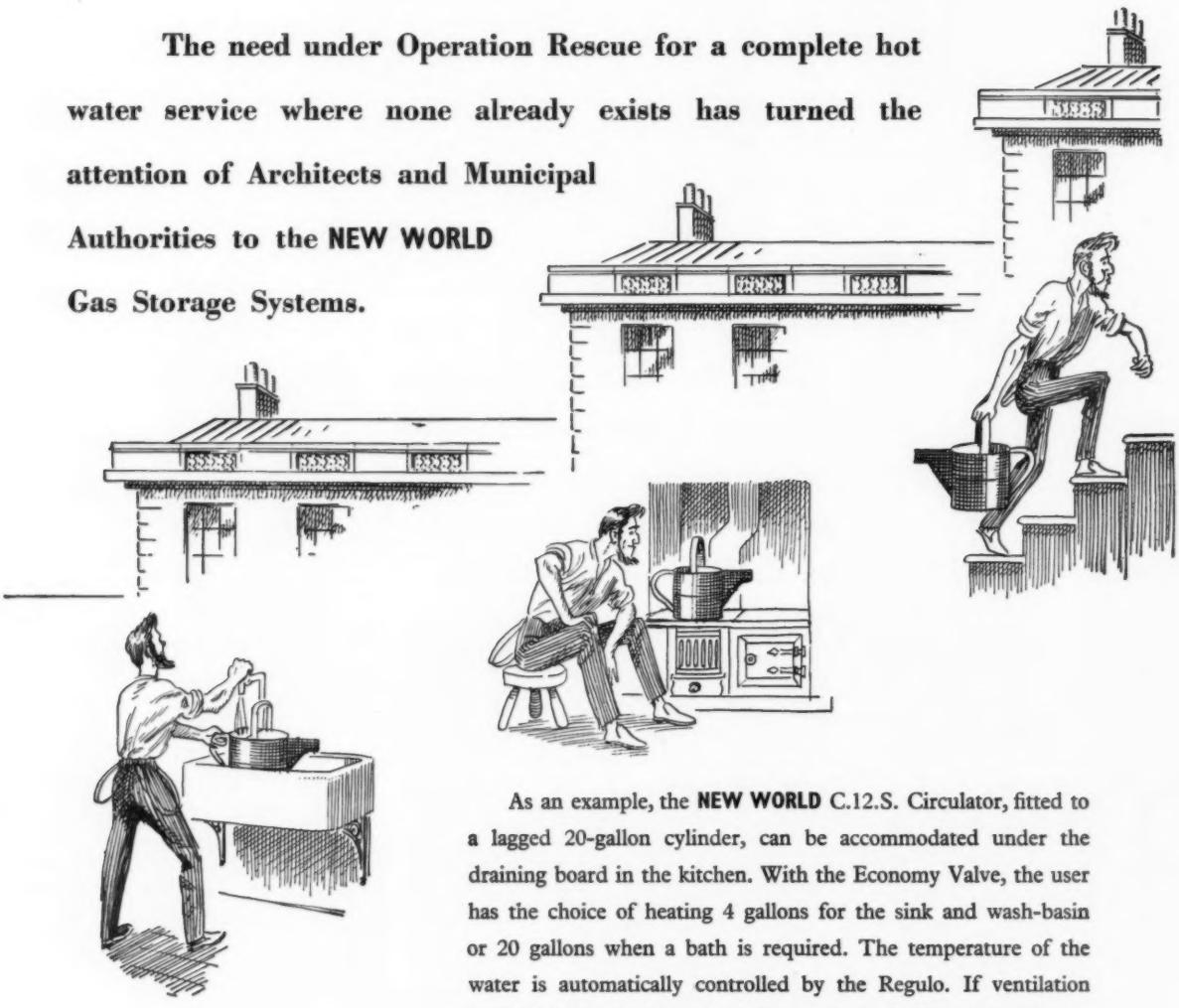

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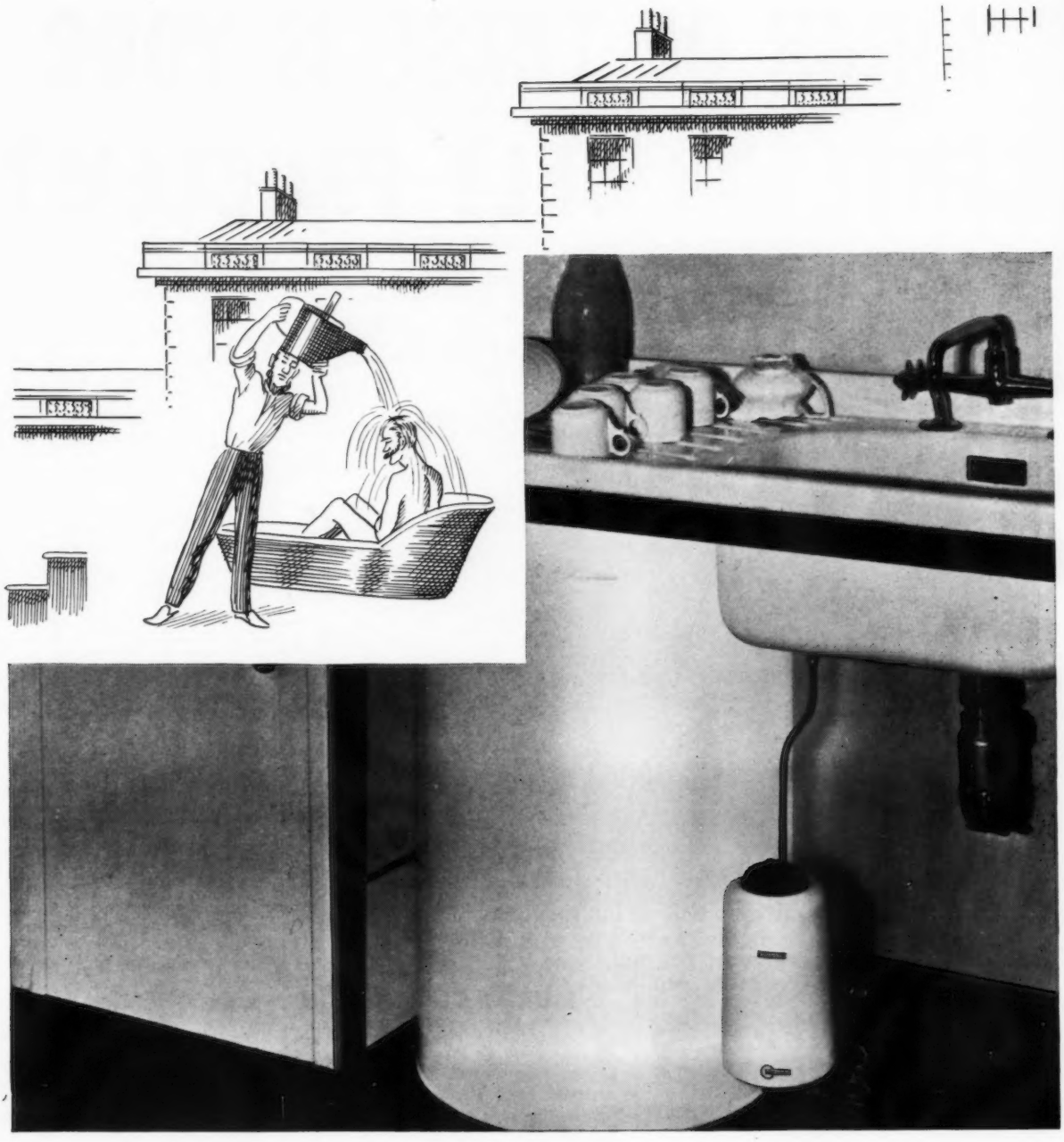

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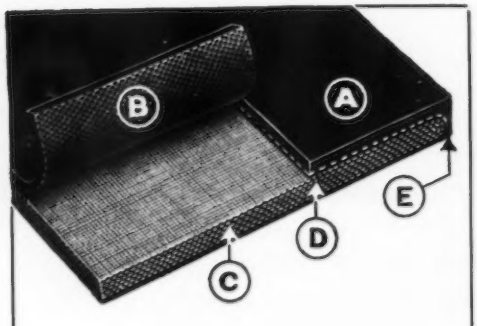

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DUBLIN DIVIDEND 'INADEQUATE'

A final dividend of 3½% for the year ended December 31, 1954, was declared at the annual meeting of the Alliance and Dublin Consumers' Gas Company on March 24. Professor Pierce Purcell, Chairman, reviewing the Company's activities during the year, said expenditure on providing gas mains and meters to new houses had again proved substantial, amounting to £56,000. Development expenditure of this nature was a symptom of a healthy business and indicated that gas was popular in new homes as well as older ones.

Depreciation provided in respect of meters and stoves was £37,000, reducing the net additional capital required for the period to £19,000. Accordingly, the sum by which capital expended was in excess of capital receipts at the end of 1954 was £362,000. On the revenue account both income and expenditure showed substantial increases. On the expenditure side the increase was £73,000, due principally to greater quantities of fuel used. Repairs and maintenance of works required £31,000 over last year, due to extensive renewal and reconstruction work on hand. On the other side of the account increased sales of gas showed a small increase of £8,000 after meeting the effect of price reductions equal to £40,000. Coke and tar sales brought in an additional £62,000. Allowing for other small variations, income totalled £75,000 above the corresponding period and, after providing for the year's taxation of £111,000, the final trading surplus at £94,000 was more favourable by £2,000.

Coal gave cause for apprehension, and due to the limiting of quotas by the British authorities they were experiencing difficulty in securing full requirements. Of all the difficulties which the future might hold for them, uncertain coal supplies was the most serious, and only increased production in Great Britain would solve this pressing problem. In addition to increases in the cost of coal there had been a general increase in the price of gas oil, and it was not pleasing to report that if maintained it would add a material sum to their costs for the current year. Sales of appliances to domestic consumers were greater by £50,000 over 1953, itself a record year. All apparatus was now in ample supply and sales were running above last year's level.

Mr. Michael Heffernan, a shareholder, commenting on the report, said the Directors took too complacent an attitude towards the stockholders. The financial results for the year were not satisfactory. In 1938 the Company had paid a dividend of 8% and now, 17 years later, it was proposed to pay only 7%. Each pound payable then was worth only 8s. at present day costs, and he thought stockholders should be entitled to an 18% dividend. Mr. Heffernan said the shareholders should get a square deal. The Directors were too considerate in their dealings with the Ministry of Industry and Commerce who controlled the rate of dividend.

The Chairman said that in 1953 they had made a determined effort to have the pre-war dividend rates paid, and the matter had again been brought up before the Prices Advisory Body. The Directors had no power in the matter, and until the outlook of the successive Governments changed they could do nothing about it. They knew the dividend was inadequate, but there was nothing they could do.

Mr. James J. Davy, M.A., and the Hon. William E. Wylie, Q.C., both of whom retired by rotation, were re-elected Directors. Mr. James Dennan, one of the stockholders' auditors, who also retired by rotation, was re-appointed.

NEW NORTH WESTERN EXHIBITION STAND

An unusual departure from the normal exhibition display technique is embodied in the design for the North Western Gas Board's stand in the *Daily Dispatch* Brighter Homes Exhibition in Manchester. Cookers, heaters, refrigerators, etc., are displayed in more than half a dozen booths which from their light-hearted attractiveness obviously owe a great deal of their inspiration to some Continental fairground. This Continental air is enhanced by a picture of the Champs-Elysées and the Eiffel Tower on one of the displays. The unorthodox approach has paid dividends in the number of orders and enquiries, and Eva Bartok, the Hungarian actress, who opened the exhibition with Sam Wanamaker, the actor, obviously found the display attractive. The stand was designed in collaboration with the Public Relations Division of the North Western Gas Board by Lee and Goodman Displays, Ltd., of London.

The North Western Gas Board's stand at the Brighter Homes Exhibition.

SWINDON'S BRIGHT PROSPECTS

Bright prospects for the gas industry in the Swindon district were foreseen at the recent annual dinner and dance of the Swindon Division of the South Western Gas Board. It was the first event to be held since Swindon became the centre of a division.

Mr. A. B. Horsfield, District Engineer, proposing the toast of the visitors, said that new industries and employees in the town would in the next few years be needing gas for heating, cooking, and refrigeration. They would, too, be demanding much of the industry's second fuel, coke. Welcoming the Mayor and Mayoress of Swindon (Councillor and Mrs. A. M. Bennett), he expressed appreciation of the co-operation the undertaking had received in dealing with all departments of Swindon Corporation. With further help, he hoped that parts of the town would soon become smokeless.

The Mayor, replying, agreed that the gas industry and the borough needed each other 'because of the great prospects in the very near future.' Gas was an important service, not only for Swindon, but for the nation.

Mr. W. B. Claridge, Divisional Manager, proposed the loyal toast, and welcomed recently appointed officials.

Mrs. Claridge, Mrs. Horsfield, and a large party from William Press & Son, Ltd., engineering contractors, also attended. Dancing by the company of 170 to music by the Johnny Morgan Orchestra followed.

Midland Juniors President's Day

Mr. H. J. Reynolds, President of the Midland Junior Gas Association, conducting a few of his colleagues round the Wolverhampton gasworks on 'President's Day.'

Many members of the Midland Junior Gas Association and their friends met at Wolverhampton on March 31 to pay tribute to the President, Mr. H. J. Reynolds. Mr. Reynolds is well known throughout the industry, exceptionally so in the Midlands, not only in the gas industry, but to many in the engineering world and to those who follow the fortunes of the famous football team of that town. Alderman F. Mansell, Mayor-elect of Wolverhampton, spoke of Mr. Reynolds' fine record in the town, and indeed the whole day was a personal triumph for Mr. Reynolds, for all the speakers spoke highly and sincerely of him, and the remainder echoed their sentiments.

In the morning many of the visitors took the opportunity of inspecting the Wolverhampton gasworks. Mr. W. Macnaughton is the Chief Engineer and General Manager of the Wolverhampton District. The works occupies an area of about 30 acres, divided in two by a canal. The daily manufacturing capacity is 13½ mill. cu.ft., and this includes 5 mill. cu.ft. of carburetted water gas. The carbonizing plant consists of three installations of Woodall-Duckham continuous vertical retorts. The carburetted water gas plant consists of two plants by the Power-Gas Corporation, Ltd., each of 2½ mill. cu.ft. per day capacity, and both are completely automatic and self clinkering. In addition there are three Humphreys & Glasgow hand clinkered sets, two automatic and one hand operated.

Luncheon was served in the Wulfrun Hall, Wolverhampton. MR. J. A. TOMES, Immediate Past President of the Association, in proposing the toast of the County Borough of Wolverhampton, described the Civic Hall as one of the finest in the country. He said that the name of Wolverhampton conjured up in the mind of the individual a different conception depending on their interest. The sportsman thought of its high prestige in the sporting world; the business man thought of its wide diversity of trades.

It was a happy thing that men like the Mayor and his colleagues were carrying on the work of local government and taking a pride in making their district an example to others. They were fully conscious of the important part the gas industry could and must play in helping to provide the maximum comfort for the citizen and a smokeless town which could be the envy of all.

ALDERMAN F. MANSELL, Mayor-Elect, deputizing for the Mayor, replied. He said that the Mayor, an old and close friend of Mr. Reynolds, was sorry he could not be present. He himself spoke of his friendship with Mr. Reynolds, of how well known he was in the town, and of the good work he did there.

MR. S. C. CRATHORN proposed the toast of the West Midlands, Gas Board, by virtue of the office he holds as Senior Vice-President. He had an additional claim to the honour, since there must be few who had served the West Midlands Gas Board longer than he. His service dated from May 1, 1949, though he was by no means unique in this. They had enjoyed the generous hospitality which the West Midlands Gas Board had extended to them, and he would like to thank the Board most sincerely. During the past six years the West Midlands Gas Board had led the gas industry in the area from strength to strength. While faithfully fulfilling its statutory duty to develop and maintain efficient systems of gas supply, coke production, and by-product recovery, the Board had done much to satisfy that other duty imposed by the Gas Act—to promote the welfare, health, and safety of all employees. The Board's success had been achieved despite many restrictions and disappointments, and they should not forget this.

As Juniors they knew of Mr. G. le B. Diamond's keen interest in the affairs of their Association. They trusted that every member would so serve the Association that it would prove at all times worthy of Mr. Diamond's interest. Other members of the Board also supported Mr. Diamond in that interest, and Mr. Crathorn added that these gentlemen were mostly friendly and approachable. The Board had a pioneering spirit and was pressing forward with experiment and development in order to reduce its demands on the National Coal Board and to minimize the bogey of high cost of raw material.

MR. G. le B. DIAMOND, in responding, said there could be no doubt that the saving of fuel was their only hope of

General view of the Bushbury Engineering Works of the Electric Construction Co., Ltd.

filling the gap between coal output and usage during the next 10 years. The national conscience had now been awakened to the menace of smog and here the gas industry had a great part to play in its alleviation. The Board intended to do everything possible to improve the quality and sizing of coke, but was dependent on the raw material received from the Coal Board. However, the N.C.B. was puting in a lot more cleaning plant at the pithead, and in the course of time they could hope for improvement.

The year which closed that day had been the most successful since nationalisation, for there was not only an all-time record for gas output during the recent cold weather, but their sales for the year were up by 7%, which was the highest increase in the country. Appliance sales, too, had been phenomenal and coke sales the best since vesting day. All this had been accomplished with diminished manpower and this was not altogether surprising when they read that there were 60,000 registered vacancies at the Labour Exchanges in their central area.

On the financial side the year commenced with a prospect of grave deficiencies, owing to continued rising costs. They set an economy target for each of their district undertakings and with the loyal and increasingly enthusiastic co-operation of the whole staff, these targets were reached, and this, coupled with the increased sales of gas, enabled him to go to the Consultative Council and say they would not put up the price of gas before September last year. It was not necessary to do it then and they had held the same tariff from June, 1953, until now. Unhappily, the inflationary spiral had now taken another turn and it was unlikely that they would be able to survive the year 1955 without putting up the price of gas.

The recent floods had tested the Board's emergency organization, which was found to work well. Kidderminster and Tamworth gasworks were badly flooded and the staff kept supplies of gas on the town in both places under difficult conditions. The same remarks applied to Upton-on-Severn where the works was entirely surrounded by water and it was only possible to obtain access by walking along the top of a wall.

MR. C. L. OLD, Principal of the Wolverhampton and Staffordshire Technical College, in proposing the toast of the Midland Junior Gas Association, said that when he came to Wolverhampton three years ago one of the first friendly greetings he had received was from Mr. Reynolds. He had never forgotten that and still looked forward to seeing Mr. Reynolds at the local Engineering Society and other places and to receiving the same friendly salutation. He valued Mr. Reynolds' friendship and appreciated his sterling qualities.

THE PRESIDENT, discarding his prepared speech and obviously touched by the sincere tributes he had received, thanked the previous speakers, saying that it would have been much easier to have spoken earlier in the proceedings. He was pleased to have with him no fewer than 14 Past Presidents. He could not mention them all by name, but he referred to three, namely, Mr. R. J. Rogers, Mr. W. J. Pickering, and Mr. F. A. C. Pykett. He was also glad to see so many other friends had been able to come. He was proud and privileged to be President during the Association's Jubilee Year. He recalled that he had started work first of all with the Electric Construction Company, then he worked in a brewery, before finally coming into the gas industry. Guests could draw their own conclusions. They had had a very good year and he had enjoyed it. He thanked Mr. Diamond, Mr. S. Jones, his Divisional Manager, and Mr. Macnaughton for the co-operation and friendly assistance he had received from them during his year of office. He also took the opportunity of thanking all those who had helped to make the forenoon visit to the gasworks a success.

MR. J. A. W. STRETTON, Junior Vice-President, said that in celebrating the double event of President's Day and Jubilee Year they were greatly honoured by the presence of so many guests. He was pleased to see Mr. C. C. Wood and Mr. D. K. Green, Chairman and Secretary respectively of the Midland Section of the Institution of Gas Engineers. He congratulated Mr. Wood on a very successful year of office. Another friend he welcomed was Mr. J. E. Wakeford, General Manager of the Birmingham Division of the Board. A family touch was added to the occasion for Mr. Reynolds' three sons were present. Mr. Stretton, in proposing the toast of the guests, coupled with it the name of Mr. J. C. Milne, Managing Director of the Electric Construction Co., Ltd., who was to be their host for the afternoon.

MR. MILNE, replying, said that he had been instructed by his good friend Mr. Reynolds to be brief and to tell a funny story. He would and did.

The party were taken in coaches to the works of the Electric Construction Co., Ltd. The late Thomas Parker founded the business in 1882 and together with one man and one boy, began the manufacture of electric machines and apparatus. Today the Company employs 1,600 people. The present factory at Bushbury was built in 1888, and the following year the prospectus of the Electric Construction Corporation, Ltd., was issued. In 1893 the company was reconstituted as the Electric Construction Co., Ltd. The Company in 1883 or thereabouts provided dynamos and installed underground transmission for electric lighting at Trafalgar Collieries, Forest of Dean, which installation is believed to be the earliest instance of electricity underground in this country. Of the three earliest examples of electric traction, one—that at Blackpool—was carried out by them in 1884-86. In 1887 the submarine 'Nautilus' was fitted with E.P.S. cells made by them. In 1892 the Company undertook the electrification of the Liverpool Overhead Railway—the earliest and only example of an elevated electric railway in this country. It is interesting particularly at this time, for only last week it was announced that the service was shortly to be discontinued.

Today the four principal lines of the Company are, broadly; rotating electrical machinery; switch and control gear; static transformers; and rectifiers. In machinery they have motor and generators, large and small, alternating and direct current, ordinary industrial types and machines designed for all sorts of surprising purposes. Coming to switchgear, they make control apparatus of nearly all types to control D.C. and A.C. motors and generators; switchgear of many other and complicated types, including heavy gear for central station work.

In transformers all sizes up to 10,000 kVA or more are made. The primary function of a rectifier is to convert alternating into direct current when the latter is necessary or preferable for the particular application. There is practically no limit to the size of mercury-arc rectifier that can be installed. The visitors were interested in this section of the works. By using, in multiple, bulbs of their largest sizes the Company have supplied rectifiers having capacities of 1,000 kW and over.

It was the largest works visited by the Midland Juniors this session, and the party going round were impressed by the variety of work going on and by what seemed to be an almost incredible output. Unfortunately the visit was brief and the party did not have as much time as they would have liked. They were entertained to tea by the Company.

Silver Medal Awards

The Council of the Society of British Gas Industries has again this year awarded silver medals to the Junior Gas Associations for the best paper adjudged to have been presented during the year by their members at a general meeting. Twenty-nine papers were submitted by 10 Junior Gas Associations for adjudication. The awards are as follows:

Manchester: JOHN W. PASKIN for paper, 'Efficiencies (A Comparison of Past and Present Retort House Practice).'

Midland: A. E. MASON, for paper 'Methods for the Determination of the Accuracy of Gas Metering'.

Western: DOUGLAS R. JONES, for paper 'Principles of Instrumentation'.

Yorkshire: J. G. GAUNT, for paper 'The Use of Butane for Peak Load Requirements'.

Wales and Monmouthshire: JOHN F. DAY, for paper 'Underground Pipeline Corrosion and Cathodic Protection'.

London and Southern: T. A. LUCAS for paper 'Instrumentation in the Gas Industry (A Review of Recent Developments)'.

Northern: C. H. LING, for paper 'Gas in Newton Aycliffe'.

Eastern: P. CASTON FORBES, for paper 'The Place of Nitrogen in Purging Practice'.

Scottish (Eastern): GEORGE A. WOOD, for paper 'Maintenance of Mechanical Plant'.

Scottish (Western): F. D. SOUTHWELL, for paper 'Ubique (An Industrial Gas Paper)'.

QUENCHING RETORTS AT BRIGG GASWORKS

On the left is a view of the retort house at Brigg immediately before the experiment, and on the right the quenching is seen in progress. Photographs by courtesy of the Leicester Mercury.

In consequence of the development of the North Lincolnshire gas grid, gas making ceased at the Brigg undertaking on March 28, and in collaboration with the Fulham Research Laboratories of the North Thames Gas Board, the opportunity was taken by the East Midlands Gas Board to shock cool the complete retort bench in order to collect samples of scurf adhering to the retort silica in a condition which could be expected during normal working. Three retorts of the bench, comprising four Drakes' continuous vertical retorts arranged in line, of rectangular section, had been erected in 1935, and the fourth added in 1947, and from this period it carbonized Denaby, Cadeby, or Manvers coal.

Two producers feeding into a common flue supplied the four settings, which were heated by horizontal combustion chambers into which secondary air was admitted at four points. The retorts were all silica construction, with the usual fireclay belts at top and bottom. Cooling was effected by means of an iron pipework system reducing from 3 in. diameter to ½ in. diameter spray pipes, one being provided for each horizontal pass, including the upper portion of the air circulating duct at the bottom of the retort. Since the two outer retorts only were thus treated a total of 44 spray pipes were installed in the horizontal passes and a further one at the rodding hole of each retort. Each spray pipe was perforated with four rings, each of four holes ⅛ in. diameter, equally disposed round the circumference of the pipe. The 3 in. pipe was brought to a point about 15 ft. outside the building, at ground level, and fitted with instantaneous fire hose couplings for the supply of water.

At zero the auxiliary coal hoppers had been emptied, fires drawn from each producer, and a water supply provided by a 500 gal. per minute trailer pump manned by the Lindsey County Fire Brigade was turned on at a rate of 200 gal. per minute. After the first quarter of an hour not all the water was converted to steam and increasing trickles of hot water began to find their way to ground level, but it was estimated that in the first 10 minutes of pumping some 500,000 cu.ft. of steam was generated.

After three hours pumping the flues of the two outer retorts were black, but even 24 hours after zero hour the top flues of the two middle retorts, together with the tops of the retorts themselves, were red and at a temperature of not less than 1,000°C. This was a striking illustration of the immense thermal capacity of a structure of this nature and provided an interesting commentary on the conduction of heat in a retort bench.

The experiment was originally discussed at a meeting of the Gas Council Research Liaison Committee, and afterwards the East Midlands Gas Board offered the retort house at Brigg as available for such an experiment. Mr. C. H. Lewis and Dr. R. J. Davis, Research Chemists from the Fulham Research Laboratory of the North Thames Gas Board, journeyed to Brigg to advise on methods and procedure, the preparation and carrying out of the experiment being supervised by Mr. P. C. Forbes, Scunthorpe Deputy Group Manager. The quenching was watched by Mr. Bernard Clarke, General Manager, Lincolnshire Division, Mr. D. W. Ault, Engineer, Lincolnshire Division, Mr. S. H. Stokes, Scunthorpe Group Manager, and Mr. C. E. Smith, Local Manager at Brigg. B.B.C. Television Newsreel, Gaumont British News, and some 20 reporters and photographers from local newspapers covered the event.

Similar experiments have been conducted four times before in this country, and the North Thames Gas Board Research Chemist, Mr. C. H. Lewis, has been present at all of them.

News in Brief

Gas Sales per Employee in the North Western Gas Board area during the four weeks ended February 27, were up by 4% over the average for the corresponding period of 1954. At the end of February employees numbered 19,267 (2% less than in February, 1954) while gas made available during the month amounted to 8,218 mill. cu.ft. (2% more than in February, 1954). During the first 11 months of the financial year the average weekly gas supply per employee was up by 5%.

About 200 ft. of Gas Piping especially laid on to King George's Hall, Blackburn, for the Cookeen apple pie baking contest on March 24, proved well worthwhile. Five out of the six finalists elected to use gas cookers in which to bake their entries. All three prizes were won on gas cookers, first place being awarded to Miss E. P. Latham (17), of Burnley. The gas cookers used were De La Rue G4, attractively finished in identical colour schemes of burgundy and grey, and loaned for the occasion by the North Western Gas Board. Over 3,000 people attended the finals.

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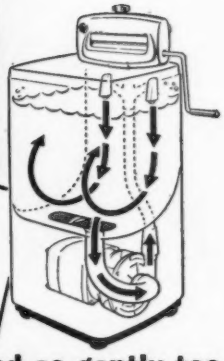

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Gas at the Factory Equipment Show

The Factory Equipment Exhibition held at Earls Court last month was the third of its kind. In 1953 the *Factory Equipment News* and the *Factory Manager* decided to sponsor an exhibition as an additional service to industry, giving managers and distributors of factory equipment an opportunity to display and demonstrate their products to industrialists, who are always looking for a better way of doing things so that production may be raised, costs lowered, and efficiency increased. This third exhibition was nearly seven times greater than the first, and so there can be little doubt about the enthusiasm with which it was regarded by industry as a whole. This year the exhibition was the scene of several conferences organized by such bodies as the British Productivity Council, the National Industrial Fuel Efficiency Service, and the Institution of Works Managers. With the stress on greater efficiency and economic operation, it was pleasing to note the number of manufacturers of gas equipment participating, and these and other firms familiar to the gas industry are mentioned in the following notes on certain of the exhibits.

On a stand which was as handsome as it was sensible, the Gas Council showed a selection of appliances for industrial processes in the canteen, for space heating, and for water heating. Small industrial equipment included a muffle furnace and a laboratory crucible furnace. Radiant heating by gas is being used for an ever-increasing range of drying processes in many different industries, and a model of a radiant heating tunnel was representative of this type of equipment. Occupying the centre of the stand, within attractive glass walls, were the catering exhibits—gas ranges, fryers, salamanders and boilers. Instantaneous gas water heaters and a gas-fired incinerator were also displayed. For space heating, overhead panel heaters, hung clear of machinery and unaffected by draughts, often provide the answer to the problem of warming large spaces efficiently. This type of appliance was represented by one of William Sugg's 'Halcyon' heaters and by a Bratt Colbran luminous panel heater. More conventional but no less efficient were the various makes of gas-fired radiators designed for works and factories. The stand was a credit to the Gas Council, and we feel sure that there was no lack of enquiries from visitors.

Combustion Engineering

The Combustion Engineering Association had an exhibit consisting of a diorama displaying a section of countryside and town containing examples of all types of industrial fuel burning equipment — blast furnaces, power station, gasworks and other heavy and light industrial concerns. All displays depicted various aspects of industrial fuel efficiency. Also concerned with giving advice was the Department of Scientific and Industrial Research, whose stand explained the effects of some recent scientific and technological developments on industrial methods and planning. It drew examples from many branches of industry and illustrated the direct application of new ideas in production processes as well as their place in the efficient use of manpower and resources.

Kitchen and tea service equipment is the speciality of G. F. E. Bartlett and Son, Ltd., and an impressive range of the company's products was displayed on their stand. Water boiling equipment for use with the well-known Bartlett insulated 'Multipot' was included, as well as automatic tea and coffee making appliances. A representative selection of larger equipment was included, such as a service counter, hot cupboard, steaming oven, fish fryer, etc.

The British Thomson Houston Co., Ltd., showed their range of electric plant and apparatus, including 'Contactor' equipment in fractional and integral horse-power electric motors, industrial electric control gear, etc., while electronic developments were demonstrated by a high speed counter and other devices. An impressive display of 'Mazda' industrial fittings, including a 'High Bay' fitting combining tungsten and mercury vapour lamps and a flame-proof fluorescent fitting was featured on the stand.

Deb Chemical Proprietaries, Ltd., showed a number of products ranging from solvents for cold de-greasing of engine parts to hand cleansers, disinfectants and detergents.

Of interest on the stand of the Dunlop Rubber Co., Ltd., were some of the uses of 'Fortiflex,' a rubber resin compound used for containers of many kinds. Protective footwear was also displayed.

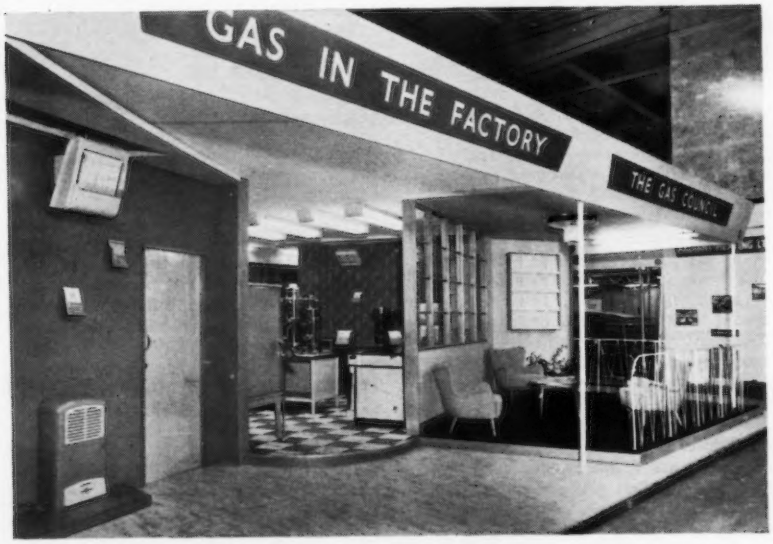
Plastic Flexible Tubing

Griflex Products, Ltd., are specialists in plastic flexible tubing, and featured on their stand was 'Bardex' patent reinforced P.V.C. tubing, which maintains a constant bore even when bent or knotted; this is because the tube is extruded with a spiral steel wire reinforcement carried within the plastic walls out of reach of fluids and gas passing through the pipe. The tube is claimed to be tough and hard wearing and resistant to many chemical solutions. It can, of course, be used with gas appliances.

'Osram' fluorescent tubes and mercury lamps drew attention to the admirable display of the General Electric Co., Ltd. Specialists in industrial lighting fittings, the company showed many examples of their products, including catering and heating appliances.

J. Glover and Sons, Ltd., exhibited the 'Compactus-Ingold' automobile space saving storage system, a new system which, it is claimed, increases storage capacity by 90-100%. Also shown was the 'Stormor' mobile storage system which increases storage capacity by 40-60%.

The Schwank patent which aroused some interest recently was incorporated in heating equipment exhibited by the Harris Engineering Co., Ltd. These infra-red radiant heaters may be either wall-mounted in the conventional manner or installed horizontally at heights of up to 50 ft. from the ground. The latter method has already been employed with success in a number of large buildings in this country. The gas at low pressure is mixed with the



A general view of the Gas Council's stand at the Factory Equipment Exhibition which was held at Earls Court. On the left is the section devoted to space heating, which included radiators and overhead panel heaters, while part of the wide range of catering equipment displayed can be seen in the centre.

right quantity of air in the burner and the mixture burns on the surface of special ceramic plates which have a low thermal conductivity. The result is a high temperature surface (800°-900°C.) which transmits infra-red rays. Also shown on the Harris stand were examples of the indirect gas-fired unit heater which is designed to provide a large volume of warm air from which the products of combustion have been excluded in order to maintain a given area at a constant temperature. Another exhibit was the cabinet air heater in which the air circulating fan is actuated by leaving air temperature and set so that the fan will not start until the heater has warmed up and will continue until the heater has cooled down after the burners have been shut down.

Instruments for Fuel Economy

Kelvin and Hughes (Industrial), Ltd., showed a comprehensive range of instruments for improved fuel economy in industry. Included among these was the 'Multiline' recorder for gas analysis and temperature measurement, which is a compact indicating and recording instrument suitable for operation with pyrometers, resistance thermometers, and gas analysers, and is ideally suited for installation in small boiler houses. Of particular interest was the 'Econometer,' a new instrument which indicates whether the working heat loss carried away in chimney gases is greater or less than a pre-determined set figure, by a varying band of colour. Independent illuminated scales show the temperature and CO_2 readings, and when unburnt gases are present a further light signal is given to discount the significance of loss and CO_2 indications.

Minimax, Ltd., exhibited their range of tea and coffee making equipment designed for factory and office canteens, including two interesting new models. The company's other products in the field of fire fighting equipment were also represented.

Industrial Stethoscope

The 'Airsonic' industrial stethoscope is, as reported in the 'JOURNAL' recently, a new acoustical instrument for locating faults by sound. It is claimed that this device will detect uneven wear or stress in moving parts, electrical faults under voltage, and gas and fluid leakages. The 'Airsonic' is self-contained and extremely compact. Moreover, it is non-electric and therefore requires no power supply. It was exhibited by the Murchie Trading Co., Ltd.

Prior Stokers, Ltd., exhibited the self-contained 'Zephair' industrial air heater, which has an output of 500,000 B.Th.U. per hour. It can be automatically fired by gas, and by gently re-circulating warm air in a building, ensuring that the desired temperature is reached in the shortest time, dispenses with the use of boiler plant. Also shown on the stand was the 'Zephair Minor,' which has an output of 250,000 B.Th.U. per hour for a structure with a capacity of some 75,000 cu.ft.

Radiant Heating, Ltd., exhibited to advantage their extensive range of factory heaters, including overhead gas radiant heaters for indoor or outdoor heating. These radiant gas burners are remarkable in that they will operate in any position and are suitable for a large variety of industrial applications such as radiant tunnels, foundry mould drying, paint drying, glass annealing, etc. Floor standing heaters were also shown, as well as gas grills and the automatic bread toaster for works canteens. The exhibit was completed by a display of 'Duoflam' burners.

Specialists in fixing anything to everything, the Rawlplug Co., Ltd., exhibited their remarkable range of expansion bolts, cavity fixing devices, hole-boring tools, etc. Of particular interest were the new improved 'Durium' tipped drills which have a rapid helix with a specially shaped flute. The new design permits the whole of the cutting face of the Durium tip to be solidly supported, and results in the speed of penetration being increased considerably.

Office Equipment

A wide range of office equipment for industry was shown by Remington Rand Ltd. The exhibits included the 'Kardex' visible record equipment showing the full range of record control purposes. Also shown was the 'Sched-U-Graph' visual control equipment which in clear pictorial form shows the whole complex set-up of a complete production plan. 'Graphdex' wall charts, filing systems and the well-known Remington Standard and portable typewriters were also exhibited.

Barrier creams are a speciality of Rozalex, Ltd., whose stand included several new creams which are developments from the continuous research and investigations by this company. Skin conditioning ointments were also shown, as well as the re-styled 'Rozalex' dispenser which is specially designed for issuing a controlled and uncontaminated supply of Rozalex when and wherever required.

Makers of protective clothing which is used throughout the world, the name of Siebe, Gorman & Co., Ltd., is today synonymous with the best in respirators, compressed air breathing apparatus, and safety clothing. Their products were not only displayed on an effective stand, but were displayed by models during a parade of protective clothing which was a feature of the exhibition.

Tangyes, Ltd., were represented by products from their three divisions. From the Foundry Division came industrial heating stoves incorporating fire bricks to prevent destruction of the body of the fire-box; from the Hydraulic Division came a range of hydraulic jacks; and from the Pump Division, which is most familiar to the gas industry, came the range of 'Duplex' steam driven pumps more than 100,000 of which have been supplied to industries throughout the world. Tangye 'AR' pumps and end-sectional centrifugal pumps were also shown.

Tubewrights, Ltd., showed a remarkable variety of welded steel tubular products, from building frames to overhead cranes and even wheel-barrow frames.

Mr. Tate Honours London Juniors

Guest of honour at a meeting of the London and Southern Junior Gas Association on April 1, was Mr. W. K. Tate, President of the Institution of Gas Engineers.

Mr. Tate said it had been asserted on a number of occasions that the standard of papers presented to the junior gas associations equalled, and indeed sometimes surpassed, the standard of papers presented to the senior sections. 'I think that is true,' he added, 'but I think you have been in danger of being caught up—not because of any fall in standard, but because perhaps the senior sections have felt the goad and made some progress.'

In this particular Association, continued Mr. Tate, the standard had always been very high. He thought that was probably due to the fact that the old London gas companies, and now the boards concerned, had inevitably employed specialists. Specialization was now spreading throughout the country. It was rather dangerous in some ways, and while it was probably necessary, it did 'lead all of us in our various activities to move a bit away from knowledge of what our colleagues are doing.' He was, therefore, delighted to see from their programme how wide a sphere of activities they did in fact cover. It was to his mind essential that this continued, so that they all knew what the others were doing.

The London Juniors laughed when Mr. Tate accused them of divorcing practice from theory when, in October last, they had visited the Houses of Parliament, and six months later they were to hear a paper on 'Subjective Response and Environment.' 'It did seem to me that those two might have gone a little closer together,' he said.

Describing the paper that had been read that evening as a 'masterly survey' of the technique and use of oils, Mr. Tate said he would not presume to take part in the discussion, but he was in the position of putting in one of the plants without any knowledge of what to expect when it began working. He would certainly listen to the discussion very keenly to find out what they might be up against.

The paper was 'Oil Gasification,' by Mr. W. J. Walters, of the North Thames Gas Board.

Census of Production Reports for 1951 relating to coke ovens and by-products (Vol. 2) and wrought iron and steel tubes (Vol. 3) were published by the Board of Trade on April 6, at 1s. 6d. each.

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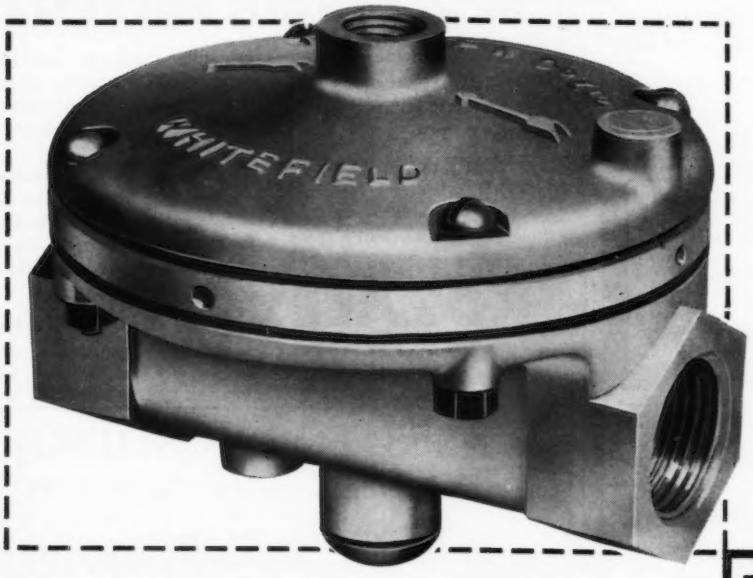

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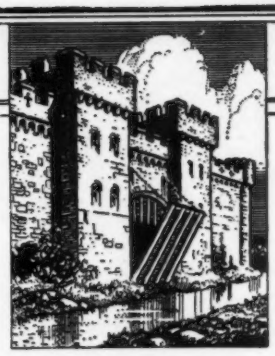

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EDITORIAL ASSISTANT required by publishers of *Gas Journal* and *Gas Service*. Applicants should be 22-25 years of age, and should combine writing ability with some knowledge of the technical aspects of the Gas Industry. This is a progressive post for a man of adaptability and initiative. Applications, which will be treated confidentially, should be made in writing to the Managing Director, Walter King, Ltd., 11, Bolt Court, Fleet Street, London, E.C.4, giving details of qualifications, experience and salary required.

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EAST MIDLANDS GAS BOARD

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DRAUGHTSMEN/TECHNICAL ASSISTANTS

APPLICATIONS are invited for the appointment of two DRAUGHTSMEN/TECHNICAL ASSISTANTS in the Divisional Distribution Office of the East Midlands Gas Board, Derby.

Applicants should have some engineering background and training and be capable of producing neat and accurate tracings, plans and site layouts, and should be fully conversant with the use of Ordnance Survey Plans. Experience in designing and drawing of simple pipework layouts would be an advantage. The positions are offered at a salary rising to £610 per annum commencing at a figure commensurate with qualifications and experience.

The positions are pensionable and the successful applicants will be required to pass a medical examination.

Applications stating age and experience, giving full particulars of training and qualifications, together with the names of two referees, should be submitted to the undersigned not later than April 23, 1955.

K. L. PEARCE,
Divisional General Manager.

East Midlands Gas Board,
Notts & Derby Division,
Friar Gate,
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SOUTHERN GAS BOARD

INDUSTRIAL GAS OFFICER

APPLICATIONS are invited for the appointment of INDUSTRIAL GAS OFFICER in the Commercial Manager's Department of the Board at a commencing salary in the region of £1,500 per annum according to qualifications and experience.

Applicants should have had experience in the design and installation of industrial plant for a range of industries, and should be able to develop the use of gas for industrial purposes throughout the Board's Area. The work will include contacting industrialists and carrying out surveys, etc.

The successful candidate will be required to pass a medical examination and, unless already subject to a pension scheme by virtue of the Gas (Pension Rights) Regulations, 1950, will be required to join the Board's Staff Pension Scheme.

Applications stating age, education, qualifications, training, experience, present appointment and salary, together with a one-page summary of these particulars, should be sent in an envelope marked "Industrial Gas Officer" to the Secretary, Southern Gas Board, 164, Above Bar, Southampton, to reach him not later than April 30, 1955.

SOUTH WESTERN GAS BOARD

DEPUTY AREA SCIENTIST

APPLICATIONS are invited from suitably qualified persons for the post of DEPUTY TO THE AREA SCIENTIST.

The commencing salary will be within the range of £1,300-£1,700 per annum, depending upon experience and ability.

It is essential that applicants should either hold a University First Class Honours Degree in Science, Fuel Technology or possess an equivalent qualification.

The successful applicant will be required to pass a medical examination and to join the Board's Pension Scheme unless he is otherwise ineligible in accordance with the Rules of the Scheme.

Applications, giving full personal particulars and details of training and experience, together with the names of three referees, must be received by the undersigned within twenty-one days of the appearance of this advertisement.

A. H. MORLAND,
Secretary and Accountant.

9a, Quiet Street,
BATH.

SCOTTISH GAS BOARD

WESTERN GROUP

APPLICATIONS are invited from qualified Accountants for the position of ASSISTANT TO GROUP ACCOUNTANT. Applications received from candidates about to qualify will be given consideration.

The commencing salary will be within Grade APT 8 of the National Salary Scales (£625-£705), and placing will be according to qualifications and experience.

The successful candidate will require to pass a medical examination and contribute to the Board's Superannuation Scheme.

Applications, stating age, qualifications and experience, together with the names of two Referees, should be addressed to the undersigned on or before Saturday, April 23, 1955.

ALEX. JAMIESON,
Group Manager.

"Kessington,"
29, Union Street,
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Classified Advertisements: All small classified advertisements are charged at 2/- per line (approx. 7 words)—minimum charge 10/-. A Box Number address occupies 2 lines, and a further 6d. is charged towards cost of postage on replies. Copy must be received by first post on Monday to ensure insertion in that week's Journal.

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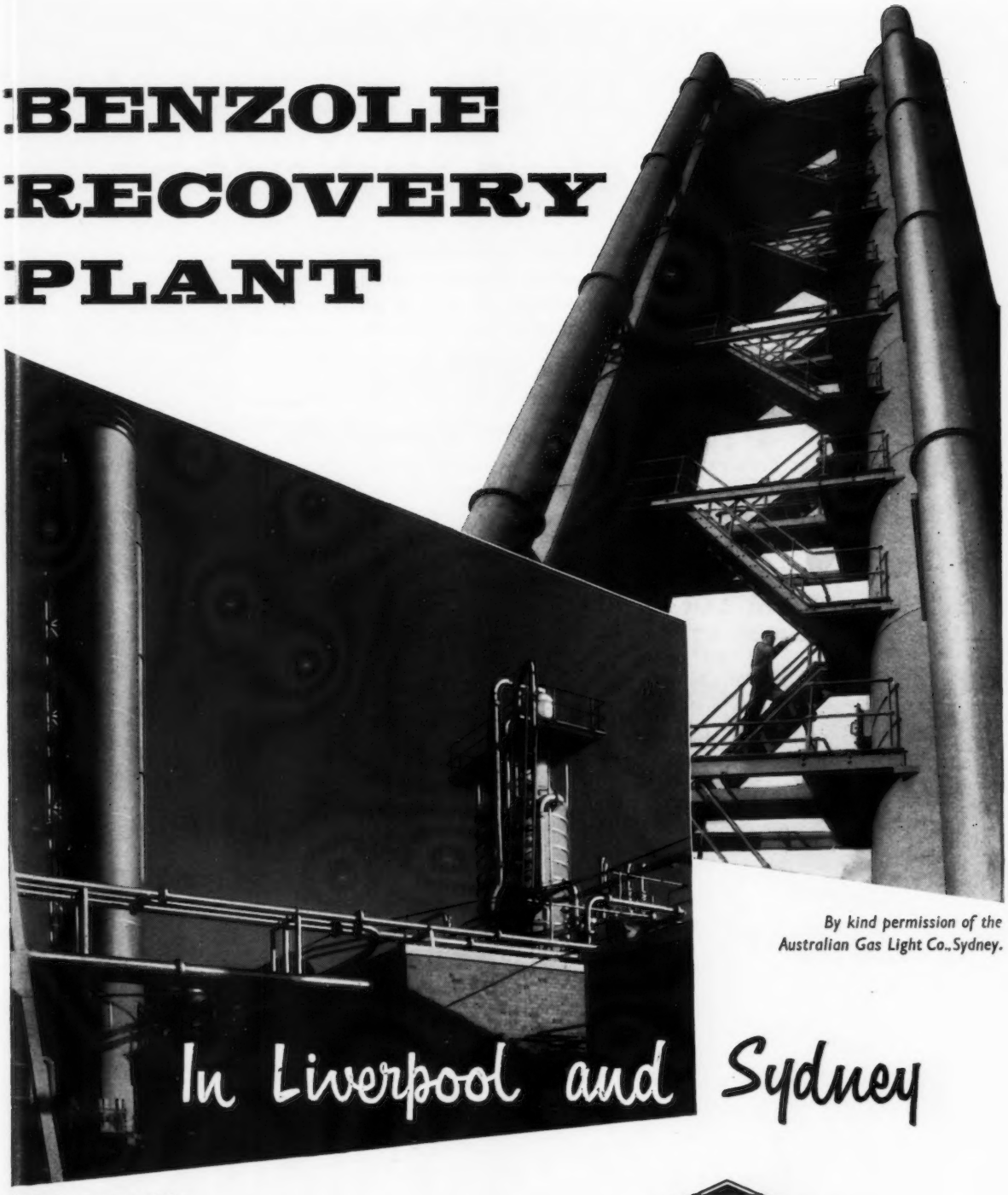

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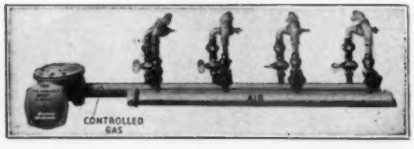

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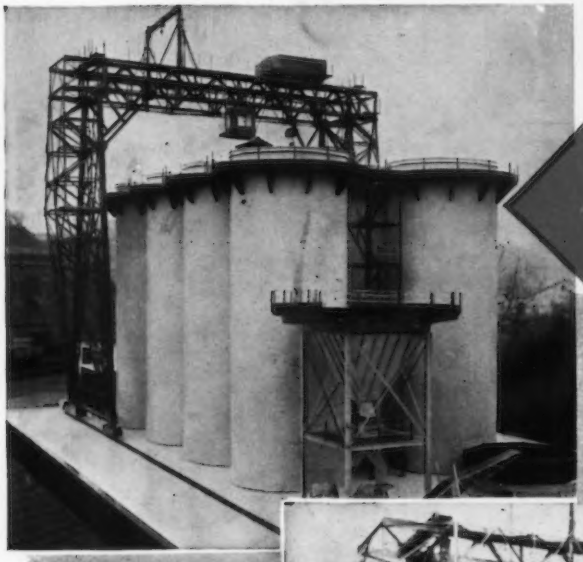

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